Institute of Engineering & Technology
Dr. Bhimrao Ambedkar University
Khandari Campus, Agra

B.E I Year (Semester-I) CE/ME (Group - B)
Course Structure & Evaluation Scheme

S No.	Code	Subject	Periods			Sessional Marks			End Semester Marks			Credit
			L	T	P	CT	TA	Total	TE	PE	Total	
1	BSC - 103	Mathematics-I	3	1	0	30	10	40	60	-	100	4
2	BSC - 102	Chemistry	3	1	0	30	10	40	60	-	100	4
3	BHSM - 101	Professional English	2	0	0	30	10	40	60	-	100	2
4	BME - 102	Workshop Concepts	2	0	0	30	10	40	60	-	100	2
5	BME - 101	Fundamentals of Electrical Engineering	3	1	0	30	10	40	60	-	100	4
6	BSC - 152	Chemistry Lab	0	0	2	20	20	40	-	60	100	1
7	BHSM - 151	Professional English Lab	0	0	2	20	20	40	-	60	100	1
8	BME - 152	Workshop Concepts Lab	0	0	2	20	20	40	-	60	100	1
9	BME - 151	Fundamentals of Electrical Engineering Lab	0	0	2	20	20	40	-	60	100	1
		Total	13	3	8	230	130	360	300	240	900	20

Group B : CE & ME.

Dean (Academics) Director

Institute of Engineering & Technology

Dr. Bhimrao Ambedkar University

Khandari Campus, Agra

B.E I Year (Semester-II) CE/ME (Group - B)

Course Structure & Evaluation Scheme

S No.	Code	Subject	Periods			Sessional Marks			End Semester Marks			Credit
			L	T	P	CT	TA	Total	TE	PE	Total	
1	BSC - 203	Mathematics-II	3	1	0	30	10	40	60	-	100	4
2	BSC - 201	Physics	3	1	0	30	10	40	60	-	100	4
3	BCS - 201	Problem Solving and Computer Programming using "C"	3	1	0	30	10	40	60	-	100	4
4	BME - 201	Engineering Graphics and Design	2	0	0	30	10	40	60	-	100	2
5	BME - 203	Elements of Mechanical Engineering	2	0	0	30	10	40	60	-	100	2
6	BSC - 251	Physics Lab	0	0	2	20	20	40	-	60	100	1
7	BCS - 251	Problem Solving and Computer Programming using "C" Lab	0	0	2	20	20	40	-	60	100	1
8	BME - 251	Engineering Graphics and Design Lab	0	0	2	20	20	40	-	60	100	1
9	BEE - 253	Elements of Mechanical Engineering Lab	0	0	2	20	20	40	-	60	100	1
		Total	13	3	8	230	130	360	300	240	900	20

Group B : CE & ME.

Dean (Academics) Director

Institute of Engineering & Technology
Dr. Bhimrao Ambedkar University
Khandari Campus, Agra

B.E I Year (Semester-I) CSE, ECE & EE (Group - A)
Course Structure & Evaluation Scheme

(Effective from academic year 2019-20)

S No.	Code	Subject	Periods			Sessional Marks			End Semester Marks			Credit
			L	T	P	CT	TA	Total	TE	PE	Total	
1	BSC - 103	Mathematics-I	3	1	0	30	10	40	60	-	100	4
2	BSC - 101	Physics	3	1	0	30	10	40	60	-	100	4
3	BCS - 101	Problem Solving and Computer Programming using "C"	3	1	0	30	10	40	60	-	100	4
4	BME - 101	Engineering Graphics and Design	2	0	0	30	10	40	60	-	100	2
5	BEE - 101	Basic Electronics Engineering	2	0	0	30	10	40	60	-	100	2
6	BSC - 151	Physics Lab	0	0	2	20	20	40	-	60	100	1
7	BCS - 151	Problem Solving and Computer Programming using "C" Lab	0	0	2	20	20	40	-	60	100	1
8	BME - 151	Engineering Graphics and Design Lab	0	0	2	20	20	40	-	60	100	1
9	BEE - 151	Basic Electronics Engineering Lab	0	0	2	20	20	40	-	60	100	1
		Total	13	3	8	230	130	360	300	240	900	20

Group A : CSE, ECE & EE.

Dean (Academics) Director

Institute of Engineering & Technology

Dr. Bhimrao Ambedkar University

Khandari Campus, Agra

B.E I Year (Semester-II) CSE, ECE & EE (Group - A)

Course Structure & Evaluation Scheme

S No.	Code	Subject	Periods			Sessional Marks			End Semester Marks			Credit
			L	T	P	CT	TA	Total	TE	PE	Total	
1	BSC - 203	Mathematics-II	3	1	0	30	10	40	60	-	100	4
2	BSC - 202	Chemistry	3	1	0	30	10	40	60	-	100	4
3	BHSM - 201	Professional English	2	0	0	30	10	40	60	-	100	2
4	BME - 202	Workshop Concepts	2	0	0	30	10	40	60	-	100	2
5	BEC - 201	Fundamentals of Electrical Engineering	3	1	0	30	10	40	60	-	100	4
6	BSC - 252	Chemistry Lab	0	0	2	20	20	40	-	60	100	1
7	BHSM - 251	Professional English Lab	0	0	2	20	20	40	-	60	100	1
8	BME - 252	Workshop Concepts Lab	0	0	2	20	20	40	-	60	100	1
9	BEC - 251	Fundamentals of Electrical Engineering Lab	0	0	2	20	20	40	-	60	100	1
		Total	13	3	8	230	130	360	300	240	900	20

Group A : CSE, ECE & EE.

Dean (Academics) Director

BSC 101 – Physics (CSE/ECE/EE)

Subject Code	BSC 101					
Category	Basic Science Course					
Subject Name	Physics					
Branches	CSE/ECE/EE					
Scheme and Credits	L-T-P	Theory Marks	Sessional		Total	Credit
			Test	Assign/Att.		
	3-1-0	60	30	10	100	4
Pre- requisites (if any)	Knowledge of Intermediate Mathematics of UP Board or equivalent Board.					

Course Objectives:

- To introduce the modern perspectives of space time geometry and the foundation of general relativity
- To provide students with knowledge and proof of the validity of physical laws and nonexistence of the hypothetical stationary ether and significance of Michelson-Morley Experiment
- To introduce the physics of electricity, magnetism electromagnetism and electromagnetic waves
- To give a coherent introduction to the development of modern physical optics with particular attention to the wave properties of light and its applications and to introduced concept of polarization
- To extend the knowledge and experience of the students in the specialized area of Laser, Holography and Optical fibers
- To give student an opportunity to pursue his/her special interest in this area through individual study and presentation of his/her work.

Course Content:

Unit I Relativistic Mechanics:

Frame of reference. Inertial & non inertial frames, Michelson Morley experiment, Postulates of special theory of relativity, Lorentz transformations, Length contraction. Time dilation, Velocity addition theorem, Variation of mass with velocity, Einstein's mass energy relation.

Subject Expert HoD/Incharge Dean (Academics) Director

Unit II Electromagnetic Field Theory:

Continuity equation for current density, Displacement current, Maxwell's equations and their physical significance, Maxwell's equations in free space, conducting and non-conducting medium, Poynting vector and Poynting theorem.

Unit-III Quantum Mechanics:

Wave particle duality, Matter waves, Heisenberg uncertainty principle and its applications Time-dependent and time-independent Schrodinger wave equation. Born interpretation of wave function. Solution to stationary state Schrodinger wave equation for one dimentional particle in a box and three dimensional.

Unit-IV Wave Optics:

Coherent sources. Interference in thin films, Newton's Rings and its applications, diffraction, Fraunhoffer diffraction, Fraunhoffer diffraction at single slit, Diffraction grating, Dispersive power, Resolving power and Rayleigh's criterion of resolution, Resolving power of telescope, Polarization, Double Refraction, Nicol Prism, Optical Activity.

Unit-V Fiber Optics & Laser:

Fiber Optics: Introduction to fiber optics, Acceptance angle. Numerical aperture, Classification of fibers, applications of Optical fiber, Laser: Absorption of radiation, Spontaneous and stimulated emission of radiation, Population inversion, Laser applications, Basic principle of Holography.

Reference Books:

1. Concepts of Modern Physics - Aurthur Beiser (McGraw Hill)
2. Introduction to Special Theory of Relaiivity. Robert Resnick (Wiley)
3. Optics - Brijlal & Subramanian (S. Chand)
4. Engineering Physics: Theory and Practical- Katiyar and Pandey (Wiley India)
5. Applied Physics for Engineers- Necraj Mehra (PI II Learning, New Delhi)

Subject Expert HoD/Incharge Dean (Academics) Director

26-9-2018

Course Outcome:

	Course Outcome (CO)	Bloom's Knowledge Level
At the end of this course, the students should be able to:		
CO 1	Establish the null results of michelson-morley experiment with interferometer of newtonian mechanics and lorentz transformation equations.	K1
CO 2	Explain time dilation, length contraction and also explain the true nature of newtonian mechanics and lorentz transformation equations	K2
CO 3	Understand the concept of constant relative motion of different bodies indifferent frames of reference	K3
CO 4	Explain and calculate the properties of waves including propagation, reflection, refraction, polarization, interference and diffraction by using the theory of waves.	K3
CO 5	The students will have sound knowledge of Maxwell's equations and the nature of electromagnetic waves and how this relates to everyday phenomenon.	
CO 6	On successful completion of this course, students will also be able to expound the basic physical principles applying to coherent light and its production with lasers.	
CO 7	Be able to relate the basic physical principle of holographic recording and reconstruction and able to make a hologram	
CO 8	Develop particular familiarity with some specialized aspect of lasers or holography, and be able to communicate this information to peers.	
CO 9	Be able to describe about optical fiber and its basic principle of propagation of light through it and also discuss its applications in different areas.	

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze,K5 – Evaluate, K6 – Create

Subject Expert HoD/Incharge Dean (Academics) Director

26.9.18 26-9-2018

26/6/18

BSC 151/BSC 251 – Physics Lab

Subject Code	BSC 151 / BSC 251					
Category	Basic Science Course					
Subject Name	Physics Lab					
Branches	All Branches					
Scheme and Credits	L-T-P	External Practical	Sessional		Total	Credit
			Test	Record &Att.		
	0-0-2	30	15	05	50	1
Pre- requisites (if any)	Knowledge of Intermediate Mathematics of UP Board or equivalent Board.					

List of Experiments:

Experiment No.	Name of Experiment
1.	To find the wavelength of sodium light by Newton's ring experiment.
2.	To find the wavelength of sodium light by Fresnel's Biprism experiment
3.	To find the wavelength of various colors of white light with the help of a Plane Transmission Grating
4.	To find the refractive index and angle of prism by using Spectrometer.
5.	To determine the specific rotation of a cane sugar solution using a Polarimeter
6.	To verify Stefan's law by electrical method
7.	The measurement of wavelength of LASER (He-Ne) light using single slit diffraction
8.	The measurement of fiber attenuation and aperture of optical fiber.
9.	To determine the energy band gap of a given semiconductor diode
10.	To draw the I-V characteristics curve of a P-N junction diode.
11.	To determine the specific resistance of a given wire using Carey Foster's Bridge.
12.	To determine the moment of inertia of a flywheel.
13.	To determine the moment of inertia of an irregular body by using the inertia table.
14.	To draw hysteresis curve of a given sample of ferromagnetic material and from this – to determine magnetic susceptibility and permeability of the given specimen.

Subject Expert HoD/Incharge Dean (Academics) Director

15.	To find the frequency of A.C. mains using Sonometer
16.	To determine the ballistic constant of a ballistic galvanometer
17.	To study the Hall effect and determine the Hall coefficient, carrier density and mobility of a given semiconductor using Hall effect set up.
18.	To determine the value of "g" by Kater's reversible pendulum.
19.	To study the elastic forces and verify the Hook's law and also determine the spring constant.
20.	To determine the value of "g" by using the Bar pendulum.

Course Outcome:

On successful completion of this course, students should be able to

	Course Outcome (CO)	Bloom's Knowledge Level (KL)
CO 1	Analyze the physical principle involved in the various instrument	K1
CO 2	Do the various experiments in the areas of optics	K2
CO 3	Do the various experiments with semiconductor devices like P-N junction Diode	K3
CO 4	Do the various experiments in magnetism and magnetic materials	K3

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Subject Expert HoD/Incharge Dean (Academics) Director

BSC 201 – Physics (CE/ME)

Subject Code	BSC 201					
Category	Basic Science Course					
Subject Name	Physics					
Branches	CE/ME					
Scheme and Credits	L-T-P	Theory Marks	Sessional		Total	Credit
			Test	Assig/Att.		
	3-1-0	60	30	10	100	4
Pre- requisites (if any)	Knowledge of Intermediate Mathematics of UP Board or equivalent Board.					

Course Objectives:

- To have basic understanding of vector mechanics.
- To introduce Newton's laws of motion, conservation of energy and linear momentum to solve advanced problems involving the dynamic motion of classical mechanics.
- To impart knowledge on rigid body mechanics.
- To widen the understanding about harmonic motion.
- To introduce the modern perspectives of space time geometry and the foundation of general relativity.
- To familiarize Maxwell's equations and their significance.

Course Content:

Unit I Vector mechanics of particles

Scalars, vectors, vector differentiation, gradient, divergence and curl, vector integration, Gauss Divergence theorem, Stokes theorem

Unit —II Mechanics of particles

Newton's laws and their applications, conservative and non-conservative forces, central force, work energy theorem, conservation of energy and linear momentum, collision, variable mass system (rocket), friction: limiting and non-limiting cases.

Subject Expert HoD/Incharge Dean (Academics) 26.09.18 Director 28.9.2018

R. Sharma 28/9/18

Unit III Rigid body motion

Definition and motion of a rigid body, translational and rotational motion, angular momentum about a point of rigid body, moment of inertia, theorems on moment of inertia, periodic motion, simple harmonic motion and harmonic oscillator, forced, Damped oscillation.

Unit— IV Relativistic mechanics

Frame of reference, inertial and non-inertial frames, Michelson Morley experiment, postulates of special theory of relativity, Lorentz transformations, length contraction, time dilation, velocity addition theorem, variation of mass with velocity, Einstein's mass energy relation.

Unit—V Electromagnetic field theory

Continuity equation for current density, displacement current, Maxwell's equations and their physical significance, Maxwell's equations in vacuum and in non-conducting medium, Poynting vector and Poynting theorem.

Reference Books:

1. J.C. Upadhyaya, mechanics, Ram Prasad and sons.
2. Concept of modern physics, Aurthur Beiser,Mc Graw Hill.
3. Engineering physics : theory and practical, Katiyar and Pandey, wiley India.
4. Introduction to special theory of relativity, Robert Resnick , Wiley.
5. David Griffiths, introduction to electrodynamics, Pearson Publisher.

Course Outcomes:

	Course Outcome (CO)	Bloom's Knowledge Level
At the end of this course, Students will be familiar with:		
CO 1	Vector Algebra.	K1
CO 2	Newton's laws	K2
CO 3	Rigid body and its mechanism	K3
CO 4	Theory of relativity and frame of references	K3
CO 5	Success to analyze the different forms of Maxwell's equations in different mediums	

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Subject Expert HoD/Incharge Dean (Academics) 26.09.18 Director 26-9-2018

R-S Verma 26/9/18

BSC 102/BSC 202 – Chemistry

Subject Code	BSC 102 / BSC 202					
Category	Basic Science Course					
Subject Name	Chemistry					
Scheme and Credits	L-T-P	Theory Marks	Sessional		Total	Credit
			Test	Assig/Att.		
	3-1-0	60	30	10	100	4
Pre- requisites (if any)	Knowledge of Intermediate Mathematics of UP Board or equivalent Board.					

Course Objective:

1. To give students deep knowledge about atomic and molecular structure.
2. To enable engineering students to identify different chemical compounds using spectroscopic techniques observed in different part of electromagnetic spectrum.
3. To familiarize students about the hardness of water, water softening techniques and phase rule.
4. To introduce engineering students about fundamentally relevant topics such as electrochemistry, corrosion and lubricants.
5. To introduce engineering students about polymeric materials, their synthesis and applications.

Unit	Content	Hours
Unit-1	Atomic and molecular structure Schrodinger Wave equation. Particle in a box solutions and their applications for conjugated molecules and nanoparticles. Molecular orbitals of diatomic Molecules. Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties. Band structure of solids and the role of doping on the band structure.	12

Subject Expert 26/9/18 HoD/Incharge 26/9/18 Dean (Academics) 26.9.2018 Director

Neeru 26/9/18

Unit-2	Spectroscopic Techniques and applications: Selection rules, Basic principle of UV – Visible spectroscopy and its applications. Basic principle of IR spectroscopy and its applications for identification of organic compounds. Basic principle of NMR spectroscopy and application of ^{1}H NMR for identification of organic compounds. Problem based on UV-VIS, IR & NMR.	8
Unit-3	(i) Hard water and its treatment: Hardness of water and its units. Disadvantages of hard water in boilers (scale and sludge formation). Water softening methods: Lime-soda, Zeolite, Ion exchange resin and Reverse osmosis. Problems based on hardness of water. (ii) Phase Rule and its application to water system.	8
Unit-4	(i) Electrochemistry: Galvanic cell, electrode potential and lead storage battery, Fuel Cell and Concentration Cell. (ii) Corrosion: Type, mechanism and causes of corrosion, prevention methods. (iii) Lubricants: Classification, mechanism and applications.	
Unit-5	Polymers: Basic concepts of polymer-Blend and composites, Conducting and biodegradable polymers. Preparation and application of some industrially important polymers (Buna-S, Buna-N, Neoprene, Nylon-6, nylon-6, 6 and Terylene). General methods of synthesis of organometallic compounds (Grignard reagent) and their applications	6

Textbook

1. Chemistry for Engineers, by S. Vairam and Suba Ramesh; Wiley India

Reference Books

1. Textbook of Engineering Chemistry by Dr. Gopal Krishna Bhatt, Acme Publishers
2. Chemistry (9th ed), by Raymond Chang, Tata McGraw-Hill
3. Engineering Chemistry Author: Abhijit Mallick, Viva Books
4. Text Book of Engineering Chemistry by Harsh Malhotra; Sonali Publications India
5. Spectrometric identification of organic compounds, R.M. Silverstein, G.C. Bassler, T. C. Morrill, 4th edition.
6. A Text book of Engineering Chemistry by Shashi Chawala

Subject Expert 26/9/18 HoD/Incharge Dean (Academics) 26.09.18 Director 26.9.2018

Neeru 26/9/18

Course Outcome:

	Course Outcome (CO)	Bloom's Knowledge Level
At the end of this course, the students should be able to:		
CO 1	Understand the basic and applied chemistry and its place in society.	K1
CO 2	The students will be unable to understand the wave equations, molecular orbital theory, crystal field theory and band structure of solids.	K2
CO 3	The students will learn about the structural analysis of compounds using spectroscopic techniques.	K3
CO 4	The students will be aware about the problems created by hard water in industry and its remedy.	K4
CO 5	The students will be updated with electrochemistry, corrosion and lubricants.	K5
CO 6	The students will learn about synthesis and application of polymers.	K6

K1 – Knowledge K2 – Understanding, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – create

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Neeru 26/9/18

BSC 152 / BSC 252 Chemistry Lab

Subject Code	BSC 152 / BSC 252					
Category	Basic Science Course					
Subject Name	Chemistry Lab					
Branches	All Branches					
Scheme and Credits	L-T-P	External Practical	Sessional		Total	Credit
			Test	Record &Att.		
	0-0-2	30	15	05	50	1
Pre- requisites (if any)	Knowledge of Intermediate with Mathematics of UP Board or equivalent Board.					

LIST OF EXPERIMENTS (Any 10)

1. Determination of alkalinity in the given water sample.
2. Determination of temporary and permanent hardness in water sample using EDTA.
3. Determination of available chlorine in bleaching powder.
4. Determination of chloride content in water sample.
5. Determination of iron content in the given solution by Mohr's method.
6. pH- metric titration.
7. Determination of Viscosity of given liquid by Ostwald viscometer.
8. Spectrophotometric determination of iron (III) using potassium thiocynate.
9. Element detection and functional group identification in organic compounds.
10. Preparation of Bakelite and Urea formaldehyde resin.
11. Thin layer chromatography.
12. Saponification/acid value of oil.
13. Chemical oscillations-Iodine clock reaction.
14. Determination of partition coefficient of a substance between two immiscible liquids.
15. Adsorption of acetic acid by charcoal.

26/9/18 26.9.18 26.9.2018

Subject Expert HoD/Incharge Dean (Academics) Director

Neeru 26/9/18

Course Outcome:

	Course Outcome (CO)	Bloom's Knowledge Level (KL)
At the end of this course, the students should be able to:		
CO 1	The students will gain knowledge of measure molecular/system properties such as viscosity, hardness, chloride and iron content in water	K1
CO 2	Use of different analytical instruments	K2
CO3	Measure hardness of water.	K3
CO4	Estimate the rate constant of reaction	K4

K1 – Remember, K2 – Understand, K3 – Apply,K4 – Analyze, K5 – Evaluate, K6 –Create

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BSC 103 – Mathematics I

Subject Code	BSC 103					
Category	Basic Science Course					
Subject Name	Mathematics-I					
Scheme and Credits	L-T-P	Theory Marks	Sessional		Total	Credit
			Test	Assig/Att.		
Pre- requisites (if any)	3-1-0	60	30	10	100	
	Knowledge of Intermediate Mathematics of UP Board or equivalent Board					

Course Objectives:

- To familiarize the undergraduate engineering students with techniques in calculus, multivariate analysis, vector calculus and linear algebra
- To equip the students with standard concepts and tools from intermediate to advanced level that will enable them to tackle more advanced level of mathematics and applications that they would find useful in their disciplines.
- To apply the knowledge of differential calculus in the field of engineering
- To deal with functions of several variables that are essential in optimizing the results of real life problems.
- To familiarize multiple integral tools to deal with engineering problems involving area, volume etc.
- To deal with vector calculus that is required in different branches of Engineering to graduate engineers
- The essential tools of matrices and linear algebra, Eigen values and diagonalization in a comprehensive manner are required.

Course Content:

1. Unit 1: Matrix and Linear Algebra

Introduction to matrices, elementary row/ column operations, Inverse and rank of matrices, Echelon form, Normal form, Linear dependence and independence, consistency of system of linear equations and their solutions, eigen values and eigen vectors, Cayley-Hamilton theorem, Diagonalisation of a Matrix,

Introduction to vector space, subspace, basis and dimensions, linear transformation and its matrix representations, Simple applications to engineering sciences.

26/9/18 — 26.9.18 — 26-9-2018

Subject Expert HoD/Incharge Dean (Academics) Director

2. Unit 2: Differential Calculus- I

Brief introduction to limits, continuity and differentiability, Successive Differentiation (n^{th} order derivatives), Leibnitz theorem and mean value theorems, Expansion of functions, Taylor's and Maclaurin's series of single variable, Curve tracing: Cartesian and Polar co-ordinates

3. Unit 3: Differential Calculus-II

Partial differentiation, Total differentiation and approximation, Euler's Theorem, Jacobians, Taylor and Maclaurin's theorems for a function of several variables, Approximation of errors, Maxima and Minima of functions of several variables, Lagrange Method of Multipliers (Simple Application),

Multiple integration: Double integral, Triple integral, Change of order of integration, Change of variables, *Application:* Areas and volumes, Beta & Gamma Functions, Dirichlet's Integrals & its Applications.

4. Unit-4: Sequences and Series

Definition of sequence, monotonic, convergence and divergence sequence, Infinite series and their convergence, Tests for convergence of series (Ratio test, root test, higher ratio test, comparison test, Integral test). Absolute and conditional convergence

5. Unit 5: Vector Calculus

Point function, differentiation, Gradient, directional derivatives, Curl and Divergence of a vector and their physical interpretation, Tangent and Normal planes.

Integration, Line, Surface and Volume integral, Stoke's, Gauss's, and Green's theorem, (without proof) and their applications.

Reference Books:-

1. B. V. Ramana, Higher Engineering Mathematics, Tata McGraw-Hill Publishing Company Ltd., 2008.
2. B. S. Grewal, Higher Engineering Mathematics, Khanna Publisher, 2005.
3. R K. Jain & S R K. Iyenger , Advance Engineering Mathematics, Narosa Publishing House 2002
4. Maurice D. Weir, Joel Hass, Frank R. Giordano, Thomas, Calculus, Eleventh Edition, Pearson.
5. D. Poole, Linear Algebra : A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
6. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
7. Ray Wylie C and Louis C Barret, Advanced Engineering Mathematics, Tata Mc-Graw-Hill; Sixth Edition.

26/9/18 — Subject Expert | HoD/Incharge | 26.9.18 — Dean (Academics) | 26.9.2018 — Director

30/9/18

Course Outcome:

	Course Outcome (CO)	Bloom's Knowledge Level
At the end of this course, the students will be able to:		
CO 1	Remember the concept of matrices and apply for solving linear simultaneous equations.	K1 & K3
CO 2	Understand the concept of limit, continuity and differentiability and apply in the study of Rolle,s , Lagrange,s and Cauchy mean value theorem and Leibnitz theorems .	K2 & K3
CO 3	Identify the application of partial differentiation and apply for evaluating maxima, minima, series and Jacobians.	K3 &K5
CO 4	Illustrate the working methods of multiple integral and apply for finding area, volume, center of mass and center of gravity.	K2 & K3
CO 5	Remember the concept of vector and apply for directional derivatives, tangent and normal planes. Also evaluate line, surface and volume integrals.	K2 & K5

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

26/9/18 — 26.9.18 — 26.9.2018

Subject Expert HoD/Incharge Dean (Academics) Director

BSC 203 – Mathematics II

Subject Code	BSC 203					
Category	Basic Science Course					
Subject Name	Mathematics-II					
Scheme and Credits	L-T-P	Theory Marks	Sessional		Total	Credit
			Test	Assign/Att.		
	3-1-0	60	30	10	100	4
Pre-requisites (if any)	Knowledge of Intermediate Mathematics of UP Board.					

Course Objectives:

- To familiarize the prospective engineers with techniques in sequences, ordinary differential equations and complex variables
- To equip the students with effective mathematical tools for the solutions of differential equations that model physical processes.
- The tool of Fourier series for learning advanced Engineering Mathematics
- The tools of differentiation of functions of a complex variables that are used in various techniques dealing with engineering problems

Course Content:

1. **Unit-1: Ordinary Differential Equation ~~of Higher Order (10 hours)~~**

Brief introduction to first order differential equations, Existence and uniqueness of solutions of initial value problems, Solution of higher order linear differential equations with constant coefficients, Cauchy- Euler equations, Solution of Second order linear differential equations by changing independent and dependent variables, methods of variations of parameters, method of undetermined coefficients, Systems of linear equations.

2. **Unit-2: Series Solutions and Special Function**

Ordinary and singular points of a differential equations, Power series solution, Frobenius method, Bessel's and Legendre equations, and their series solutions, Properties of Bessel function and Legendre polynomials, Generating functions, Fourier-Bessel expansion.

3. **Unit -3 Laplace Transform**

Laplace Transform, Existence conditions and ROC, Inverse Laplace transform, Operational properties, Convolution, unit step function, Dirac-Delta function, periodic functions, Applications to IVP and BVP, linear ordinary differential equations. Applications to control systems analysis.

Subject Expert HoD/Incharge Dean (Academics) Director

4. Unit – 4 Partial Differential Equations and Fourier Series

Development of partial differential equations and their solutions, Solution of first order partial differential equations, solutions of linear higher order partial differential equations with constant coefficients.

Orthogonal functions, Fourier series, existence conditions, Fourier series with arbitrary periods, change of intervals, Fourier series of even and odd functions, Fourier half range series, Harmonic Analysis.

5. Unit – 5 Modeling and Boundary Value Problems,

Modelling of heat flow and vibrating string; derivation of heat flow, wave and Laplace equations in rectangular coordinates, boundary value problems and their solutions by the methods of separation of variables, Non homogeneous equations and boundary conditions, Boundary value problems in polar, cylindrical and spherical coordinate systems and their solutions.

Reference Books:-

1. Dennis G, Zill & Michael R Cullen; Advanced Engineering Mathematics, 2nd Edition, Jones & Bartlett Publishers
2. E. Kreyszig, Advance Engineering Mathematics, John Wiley & Sons, 2005.
3. Peter V. O'Neil, Advance Engineering Mathematics, Thomson (Cengage) Learning, 2007.
4. Maurice D. Weir, Joel Hass, Frank R.Giordano, Thomas, Calculus, Eleventh Edition, Pearson.
5. G.B Thomas, R L Finney, Calculus and Analytical Geometry, Ninth Edition Pearson, 2002.
6. James Ward Brown and Ruel V Churchill, Fourier Series and Boundary Value Problems, 8th Edition-Tata McGraw-Hill
7. D. Poole , Linear Algebra : A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
8. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
9. B. V. Ramana, Higher Engineering Mathematics, Tata McGraw-Hill Publishing Company Ltd., 2008.
10. B. S. Grewal, Higher Engineering Mathematics, Khanna Publisher, 2005.
11. R. K. Jain & S. R. K. Iyenger , Advance Engineering Mathematics , Narosa Publishing -House, 2002.

Subject Expert HoD/Incharge Dean (Academics) Director

BCS101/ BCS201 – Problem Solving and Computer Programming using "C"

Subject Code	BCS 101 / BCS 201					
Category	Basic Engineering Course					
Subject Name	Problem Solving and Computer Programming using "C"					
Scheme and Credits	L-T-P	Theory Marks	Sessional		Total	Credit
			Test	Assign/Att.		
	3-0-0	60	30	10	100	3
Pre- requisites (if any)	-					

Course Objectives:

- To make students understand basics of parts of computers and the programming.
- To give knowledge of basic constructs of computer programming.
- To make students understand Recursion.
- To impart knowledge of Basic Algorithms

Unit- 1	**Basics of programming:** Introduction to Problem Solving through Programs, Flow charts, Pseudo Codes. The compilation process, syntax and semantic errors, variable and data types. **Arithmetic expressions and conditional branching,** Arithmetic expressions and Relational operations, mixed operands, type conversion, logical operators, bit operations, assignment operator, operator precedence and associativity. Structure of C program, writing and executing the first C program, components of C language. Standard I/O in C.	9
Unit- 2	**Conditional program execution:** Applying if and switch statements, nesting if and else, use of break and default with switch, program loops and iterations: use of while, do while and for loops, multiple loop variables, use of break and continue statements, standard C preprocessors, defining and calling macros, conditional compilation, passing values to the compiler	8
Unit- 3	**Functions & Arrays:** Introduction, Need of "C" Functions, Prototypes of Functions, Types of functions, Nesting of functions, Recursion. Passing values to functions, recursive functions. Definition of Array, Declaring & Initializing Arrays, Array notation and representation, manipulating array elements. Multi dimensional arrays, Character and String arrays, String handling functions.	9

Subject Expert 26/9/18 HoD/Incharge 26/9/18 Dean (Academics) 26.9.18 Director 26.09.2018

Unit- 4	**Pointers:** Introduction to pointers, Declaration and Initialization of pointers, Accessing the address of the variables, Pointers operators, Pointer arithmetic. Dynamic memory allocation. **Structure:** Definition, defining structure, Declaration of Structure Variable, Accessing Structure members, Array of Structures. **Union:** Defining and Declaration of Union, Difference between union & structure.	9
Unit- 5	**File Handling:** Basis of the file handling. File pointers. Primary file handling functions (fopen, fscanf or fgetc, fprintf or fputs, fseek, rewind, fclose, EOF etc.)	5

Text & Reference Books:

- Schaum's Outline of Programming with C by Byron Gottfried , McGraw-Hill
- The C programming by Kernighan Brain W. and Ritchie Dennis M., Pearson Education.
- Computer Basics and C Programming by V.Rajaraman , PHI Learning Pvt. Limited, 2015.
- Computer Concepts and Programming in C, E Balaguruswami, McGraw Hill
- Computer Science- A Structured Programming Approach Using C, by Behrouz A. Forouzan, Richard F. Gilberg, Thomson, Third Edition , Cengage Learning - 2007.
- Let Us C By Yashwant P. Kanetkar
- Problem Solving and Program Design in C, by Jeri R. Hanly, Elliot B. offman, Pearson Addison-Wesley, 2006

Course Outcome:

Course Outcome (CO)		Bloom's Knowledge Level (KL)
At the end of course , the student will be able to understand		
CO 1	To develop the awareness about the Unix system, simple algorithms for arithmetic and logical problems.	K2, K3
CO 2	To translate the algorithms to programs & execution (in C language).	K3
CO 3	To implement conditional branching, iteration and recursion.	K3
CO 4	To decompose a problem into functions and synthesize a complete program using divide and conquer approach.	K4
CO 5	To use arrays, pointers and structures to develop algorithms and programs.	K2, K3

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

26/10/18 26/9/18 6/9/18 26.09.

Subject Expert HoD/Incharge Dean (Academics) Director

BCS 151 / BCS 251 Computer Programming Laboratory

Subject Code	BCS 151 / BCS 251					
Category	Basic Engineering Course					
Subject Name	Computer Programming Lab					
Scheme and Credits	L-T-P	External Practical	Sessional		Total	Credit
			Test	Record &Att.		
	0-0-3	30	15	05	50	1.5
Pre- requisites (If any)	Knowledge of Intermediate Mathematics of UP Board or equivalent Board.					

List of Experiments

The laboratory should be preceded or followed by a tutorial to explain the approach or algorithm to be implemented for the problem given.

Lab 1: Problem solving using computers

Familiarization with programming environment

Lab 2: Variable types and type conversions

Simple computational problems using arithmetic expressions

Lab 3: Branching and logical expressions

Problems involving if-then-else structures

Lab 4: Loops, "while and for loops

Iterative problems e.g., sum of series

Lab 5: 1D Arrays: searching, sorting

ID Array manipulation

Lab 6: 20 arrays and Strings

Matrix problems, String operations

Lab 7: Functions, call by value

Simple functions

Lab 8: Numerical methods (roots finding, numerical differentiation, numerical integration)

Lab 9: Programming for solving Numerical methods problems

Subject Expert HoD/Incharge Dean (Academics) Director

Lab 10: Recursion, structure of recursive calls

Recursive functions

Lab 11: Pointers, structures and dynamic memory allocation

Pointers and structures

Lab 12: File handling

File operations

Course Outcomes:

1. To formulate the algorithms for simple problems.
2. To translate given algorithms to a working and correct program to be able to correct syntax errors as reported by the compilers.
3. To be able to identify and correct logical errors encountered at run time.
4. To be able to write iterative as well as recursive programs.
5. To be able to represent data in arrays, strings and structures and manipulate them through a program.
6. To be able to declare pointers of different types and use them in defining self-referential structures.
7. To be able to create, read and write to and from simple text files.

BEE101/BEE201-Fundamentals of Electrical Engineering

Subject Code	BEE101/ BEE 201					
Category	Fundamentals of Engineering Course					
Subject Name	Fundamentals of Electrical Engineering					
Scheme and Credits	L-T-P	Theory Marks	Sessional		Total	Credit
			Test	Assign/Att.		
	3-1-0	70	20	10	100	4
Pre- requisites (If any)	Knowledge of Intermediate Mathematics of UP Board or equivalent Board.					

Course Objective:

- To help the students understand and analyze dc and ac circuits.
- To help acquire thorough understanding of RLC circuits and to be able analyze the same.
- To impart basic knowledge of electric machines
- To provide elementary knowledge of electric installations

Course Content:

Unit-I Electrical Circuit Analysis: (8 hours)

Circuit Concepts: Active and Passive elements, Voltage and Current sources, Concepts of linearity and linear network, Unilateral and bilateral elements, Source transformation, Kirchoff's laws, Loop and Nodal Analysis, Star-Delta transformation

Network theory: Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum Power Transfer theorem

Unit-II Steady State Analysis of AC Circuits: (8 hours)

AC Fundamentals: Sinusoidal waveform generation – Average and Effective values, Form and peak factors, Concepts of phasors, Behavior of R,L,C and their combinations, concepts of impedance, power, power factor, Analysis of series and parallel RLC circuits, Series and parallel resonance, band width, Q factor.

Three Phase AC Circuits: Necessity and advantages, Star Delta connections, Balanced supply and balanced load, Line and phase voltages / currents relation.

Subject Expert | HoD/Incharge | Dean (Academics) 26.9.18 | Director 26.9.2018

Unit-III Magnetic Circuits & Transformers: (8 hours)

Magnetic Circuits: Analogy between electric and magnetic circuits, Magnetic leakage and fringing, Hysteresis, Eddy current losses, Self-induction, Mutual induction

Transformer: Single Phase Transformer - Principle of operation, Construction, EMF equation, equivalent circuits, Power losses, Efficiency, Open and Short Circuit tests, Voltage Regulation, Autotransformer, Three- phase transformer connections

Unit IV Electrical Machines (8 hours)

Generation of rotating magnetic fields, Construction and working of a three- phase induction motor, Significance of torque - slip characteristics, Loss component and efficiency, Starting and speed control of Induction motor. Single phase induction motor – Construction and working.

Unit V Electrical Measurements and Installations (8 hours)

Measurement of voltage and current using PMMC, MI meters, Measurement of power and energy Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of wire and cables, Earthing, Batteries – Important Characteristics - Types of batteries – Elementary calculations for energy consumption, Power Factor improvement and battery backup.

Text Books:

1. D.P. Kothari and I.J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010.
2. E Hughes, "Electrical and Electronics Engineering", Pearson 2010.
3. V Del Toro, "Principles of Electrical Engineering", Prentice Hall India, 1989.

Reference Books:

1. W.H. Hayt & J.E. Kemmerly, Engineering Circuit Analysis, TMH Publications.
2. B.L. Theraja, Electrical Technology Volume I and II, S Chand Publications.
3. D. C. Kulshreshtha, "Basic Electrical Engineering", Tata McGraw Hill, 2009.
4. A.K.Sawhney, "A course in Electronic Measurements and Instrumentation", Dhanpat Rai & Co.

Subject Expert HoD/Incharge Dean (Academics) Director

Course Outcome:

	Course Outcome	Bloom's Knowledge Level
At the successful completion of the course students will be		
CO 1	Able to understand and analyze basic electrical and magnetic circuits	K4
CO 2	Able to comprehend the phenomenon of resonance in electrical circuits	K2
CO 3	Able to comprehend the working principle of static and dynamic electrical machines	K2
CO 4	Able to measure basic electrical quantities	K3
CO 5	Familiar with components of low voltage electrical installations	K2

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

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Subject Expert HoD/Incharge Dean (Academics) Director

26.9.18 20.9.2018

BEE151/BEE251 - Electrical Engineering Laboratory

Subject Code	BEE151 /BEE 251					
Category	Basic Engineering Course					
Subject Name	Electrical Engineering Lab					
Scheme and Credits	L-T-P	External Practical	Sessional		Total	Credit
			Test	Record &Att.		
	0-0-2	30	15	05	50	1
Pre- requisites (if any)	Knowledge of Intermediate Mathematics of UP Board or equivalent Board.					

List of Experiments

1. Verification of Kirchoff's Laws
2. Verification of Superposition Theorem
3. Verification of Maximum Power Transfer Theorem
4. Verification of Thevenin's Theorem
5. Determination of parameters of Single Phase AC Series circuit
6. Study of the phenomenon of Resonance in RLC Series Circuit
7. Open Circuit and Short Circuit Tests of a Single Phase Transformer
8. Polarity Test and Load Test of a Single Phase Transformer
9. Connection of a Fluorescent Lamp and Measurement of Power Consumed
10. Load test on Three phase Induction motor
11. Speed Control of Induction Motor
12. Study of Components of LT Switchgear

Course Outcome:

After course completion, the students shall be able to

- Demonstrate the concepts of Network Theory practically
- Measure voltage, Current, Power using appropriate electrical Measuring Instruments
- Conduct various tests on Single Phase Transformer
- Demonstrate the working and speed control of Induction motors
- Identify and comprehend the working of LT switchgear

Subject Expert HoD/Incharge Dean (Academic) 28.9.18 Director 28.9.2018

BME101/BME201- Engineering Graphics & Design

Subject Code	BME 101 / BME 201 and BME 151 / BME 251											
Category	Basic Engineering Course											
Subject Name	Engineering Graphics & Design											
Scheme and Credits	L-T-P	Theory Marks					Practical Marks					Credit
		Sessional			Ext.	Total				Ext.	Total	
		CT	TA	Tot.			CT	TA	Tot.			
	2-0-2	30	10	40	60	100	15		20			2
Pre-requisites (if any)	Knowledge of Intermediate Mathematics of UP Board or equivalent Board.											

Engineering Graphics & Design - (Theory & Lab)

Course objectives

- To enable students to acquire and use engineering drawing skills as a means of accurately and clearly communicating ideas, information and instructions.
- To enable students to acquire requisite knowledge, techniques and attitude required for advanced study of engineering drawing

Course Content

UNIT I

BASICS OF ENGINEERING GRAPHICS AND DRAWING – Drawing Papers, Mini-drafter, Pencils. Drawing Paper Layout, Title Block, Types of Lines, Lettering, Dimensioning, types of Projections; First and Third Angle systems of Orthographic Projections. Projection of Points in different Quadrants.

PROJECTIONS OF STRAIGHT LINES – Contained by both Reference Planes, contained by one and inclined to other Reference Plane, Contained by one and Parallel to other Reference Plane, Parallel to both Reference Plane, Perpendicular to one of the Reference Planes, inclined to one Plane but Parallel to the other Reference Planes, Inclined to both the Reference Planes, True Length of a Line and its Inclination with Reference Planes, Traces of a Line.

UNIT II

PROJECTIONS OF PLANES – Parallel to one Reference Plane, inclined to one Plane but Perpendicular to the other, Inclined to both Reference Planes.

PROJECTIONS OF POLYHEDRAL SOLIDS AND SOLIDS OF REVOLUTION- in simple positions with axis perpendicular to a Reference Plane, with axis parallel to both Reference Planes, with axis parallel to one

Reference Plane and inclined to the other Reference Plane, Projections of sections of Prisms, Pyramids, Cylinders and Cones. True Shape of Sections of Solids.

UNIT III

DEVELOPMENT - Development of Surfaces of various Solids objects.

FREE HAND SKETCHING - Orthographic Views from Isometric, Views of Simple Machine Components such as Brackets, Bearing Blocks, Guiding Blocks and Simple Couplings and Pipe Joints.

UNIT IV

ISOMETRIC PROJECTIONS - Introduction, Isometric Scale, Isometric Views and Drawing of various Plane and Solids objects. Perspective drawing and oblique view.

UNIT V

COMPUTER GRAPHICS – Introduction to computer technology that impact on graphical communication, Engineering Graphics software – spatial transformations, orthographic projections, model viewing, co-ordinate system, multi-view projection, exploded assembly, animation, solid modeling. Suggested

Textbook:

(i)Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House

(ii)Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education

Reference Books:

(i)Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication

(ii)Narayana, K. L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers

(iii)Corresponding set of) CAD Software Theory and User Manuals

Subject Expert HoD/Incharge Dean (Academics) Director

Course Outcomes:

Course Outcome (CO's) At the end of this course, the students should be able to:		Bloom's Knowledge Level (KL)
CO 1	Introduction to engineering design and its place in society	K1 and K2
CO 2	Exposure to engineering graphics standards	K2 and K3
CO 3	Exposure to solid modeling	K3 and K4
CO 4	Exposure to computer-aided geometric design	K3 and K5
CO 5	Exposure to creating working drawings	K6

K1-Remember, K2-Understand, K3-Apply, K4- Analyze, K5-Evaluate, K6-Create

Subject Expert (Dr. Anand Kumar) HoD/Incharge 20/9/18 Dean (Academics) 21.9.18 Director 20.9.2018

BME102/BME202- Workshop Concepts

Subject Code	BME 102 /BME 202					
Category	Basic Engineering Course					
Subject Name	Workshop Concepts					
Scheme and Credits	L-T-P	Theory Marks	Sessional		Total	Credit
			Test	Assig/Att.		
	2-0-0	60	30	10	100	2
Pre- requisites(if any)	Knowledge of Intermediate Mathematics of UP Board or equivalent Board.					

Why you need to study this course.

The course will help in understanding various operations of manufacturing processes

Course Objective:

- To become familiar with various manufacturing processes.
- To become familiar with usage of various manufacturing instruments.
- To become familiar with various operations.
- To learn to use instruments with safety precautions.

Sl. No.	Topics	Lec.
UNIT 1	Carpentry Shop • Basic concepts • Types of woods and their properties • Seasoning of wood • Carpentry tools • Carpentry Processes • Carpentry joints & their applications Fitting Bench Working Shop • Introduction • Vices • Fitting tools • Fitting Processes & their applications	6
UNIT 2	Welding Shop • Introduction to welding • Weldability and types of joints • Types of welding and its defects • Metallurgy of Weld • Arc Welding, Gas welding, Resistance Welding, Soldering & Brazing & their applications	4

Subject Expert HoD/Incharge 25/9/18 Dean (Academics) 26.9.18 Director 26.9.2018

UNIT 3	Sheet Metal Shop • Introduction to sheet metal shop • Metals used in sheet metal works • Hand tools and accessories e.g. different types of hammers, hard and soft mallet • Sheet Metal operation & their applications • Sheet Metal Joints Hems and Seams • Sheet metal allowance • Sheet Metal working machines Black Smithy Shop • Introduction • Forging Material • Hot working and Cold working process • Heating devices, Hand tools and Appliances • Smith Forging operations & their applications Forging Processes & its defects	6
UNIT 4	Foundry Shop • Introduction • Pattern Materials • Pattern making tools • Types of Pattern • Pattern Making allowances • Method of Constructing a pattern • Moulding sand & its types • Moulding sand size and shape • Sand additives • Moulding Processes & their applications • Cupola furnace	4
UNIT 5	Machine Shop • Introduction to machine tools and machining processes; • Types of cutting tools • Selection of cutting speeds and feed • Simple machining operations on Lathe, shaper, Milling machine, Drill machine, Planer & their applications Modern trends in manufacturing, Automation. Introduction to NC/CNC/DNC, FMS, CAD/CAM, CIM and factory of future, Additive manufacturing.	6

Subject Expert HoD/Incharge 28/7/18 Dean (Academics) 27.9.18 Director 26.9.2018

Acts

Text Books and References:

1. Workshop Technology by S. K. Garg University Science Press Publications.
2. Raghuwanshi,B S "Workshop Technology ; vol. I&II" Dhanpat Rai & Sons
3. Chaudhary, Hajra "Elements of Workshop Technology; vol. I&II" Media Promoters & Publishers.
4. Hajra Choudhury S. K., Hajra Choudhury A. K. and Nirjhar Roy S. K., "Elements of Workshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
5. Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGraw Hill House, 2017.

Course Outcome:

	Course Outcome (CO)	Bloom's Knowledge Level (KL)
At the end of this course, the students should be able to:		
CO 1	The students will gain knowledge of the different manufacturing processes which are commonly employed in the industries.	K2
CO 2	Fabricate components using different materials.	K3
CO 3	The students will be aware about new trends used in industries.	K3
CO 4	The attitudes, abilities, and skills required to adapt to rapidly Ahanging	K1

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – create

Subject Expert HoD/Incharge Dean (Academics) Director

BME 152 / BME 252 Workshop Concept Lab

Subject Code	BME 152 / BME 252					
Category	Basic Engineering Course					
Subject Name	Workshop Concept Lab					
Scheme and Credits	L-T-P	External Practical	Sessional		Total	Credit
			Test	Record &Att.		
	0-0-2	30	15	05	50	1
Pre- requisites(if any)	The subject requires basic knowledge of mathematics and measuring equipments					

LIST OF EXPERIMENTS

Ex. No.	Experiment	Objective	Expected Outcome
1	Carpentry Shop	• To understand different types of woods and their properties. • Study various tools & equipments used in carpentry. • To prepare half-lap corner joint, Mortise & tenon joints.	To perform different types of operations on woods (such as sawing, joint making etc).
2	Fitting Bench Working Shop	• Introduction to fitting tools, Study of tools & operations. • Simple exercises involving fitting work. To make perfect V slot. • Simple exercises involving drilling/tapping.	To get familiarized with various Fitting operations
3	Black Smithy Shop	• Introduction and demonstration of various black smithy operations. • To perform operation for making L- shaped nail	To be able to learn Forming operations (such as bending, upsetting and drawing).
4	Welding Shop	• Introduction to welding and welding equipment. • To learn operations of Gas welding & Arc welding. • To learn Simple butt and Lap welded joints. • To learn resistance spot welding and cutting.	To get familiarized with Electric arc welding and Oxyacetylene gas welding.
5	Sheet Metal Shop	• Introduction to tools and operations in sheet metal shop. • Fabrication of tool-box, tray, electric panel box etc. • Making Funnel complete with 'soldering'.	To be able to learn various sheet metal operations.

Subject Expert HoD/Incharge Dean (Academics) Director

6	Machine Shop	• Introduction to Lathe machine and its various operations. • To perform Plane turning, Step turning, Taper turning & Threading. • Introduction of Single point cutting tool grinding.	To get familiarized with Lathe machine and various machining operations.
7	Foundry Shop	• Introduction to foundry tools. • To study different types of molding sands. • Mould making with the use of a core and Casting.	To get familiarized with various Foundry techniques.

Text Books:

1. Raghuwanshi B.S., Workshop Technology Vol. I & II, Dhanpath Rai & Sons.
2. Kannaiah P. and Narayana K.L., Workshop Manual, 2nd Edn, Scitech publishers.
3. John K.C., Mechanical Workshop Practice. 2nd Edn. PHI 2010.
4. Jeyapoovan T.and Pranitha S., Engineering Practices Lab Manual, 3rd Edn. Vikas Pub.2008.

Course Outcome:

	Course Outcome (CO)	Bloom's Knowledge Level (KL)
At the end of this course, the students should be able to:		
CO 1	Study and practice on machine tools and their operations	K2
CO 2	Practice on manufacturing of components using workshop trades including fitting, carpentry and foundry.	K3
CO 3	Identify and apply suitable tools for machining processes including turning, facing, thread cutting and tapping	K4
CO 4	Welding and soldering operations	K3

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Subject Expert (Dr. Manoj Kumar) HoD/Incharge 7/9/18 Dean (Academics) 6.9.18 Director 26.9.2018

BME 103/ BME 203 Elements of Mechanical Engineering

Subject Code	BME 203					
Category	Basic Engineering Course					
Subject Name	Elements of Mechanical Engineering					
Branches	All Branches					
Scheme and Credits	L-T-P	Theory Marks	Sessional		Total	Credit
			Test	Assign/Att.		
	2-0-0	60	30	10	100	2
Pre- requisites (if any)	Knowledge of Intermediate Mathematics of UP Board or equivalent Board.					

Course Objectives:

- To strengthen the concepts of Force, Moment of Inertia etc.
- To introduce the basics of Thermodynamics
- To familiarize IC Engines

Course Content:

UNIT-I

Force System: Force, Parallelogram Law, Lami's theorem, Principle of Transmissibility of forces. Moment of a force, Couple, Varignon's theorem, Resolution of a force into a force and a couple. Resultant of coplanar force system. Equilibrium of coplanar force system, Free body diagrams.

UNIT-II:

Concept of Centre of Gravity and Centroid and Area Moment of Inertia, Perpendicular axis theorem and Parallel axis theorem.

Friction: Concepts of friction and its types, Dry friction, Laws of friction and their applications to wedge.

UNIT-III:

Plane Truss: Perfect and imperfect truss, Assumptions and Analysis of Plane Truss by Method of joints and Method of section.

Beams: Types of beams, Statically Determinate Beams, Shear force and bending moment in beams, Shear force and bending moment diagrams, Relationships between load, shear and bending moment.

Subject Expert | HoD/Incharge | Dean (Academics) | Director

UNIT-IV:

Basic Concepts and Definitions of Thermodynamics: Introduction and definition of thermodynamics, Microscopic and Macroscopic approaches, System, surrounding and universe, Concept of continuum, Thermodynamic equilibrium, Thermodynamic properties, path, process and cycle, Quasi static process, Energy and its forms, Work and heat. Thermodynamic definition of work. Temperature and its measurement.

UNIT-V:

Introduction to I C Engine: Classification of I C Engines and their parts, working principle and comparison between Two stroke and Four stroke S.I. and C.I. engine, expression for the efficiency of Otto cycle and Diesel cycle.

Text Books:

1. Engineering Mechanics by R K Bansal, Laxmi Publications.
2. Engineering Mechanics by S. S. Bhavikatti, K. G. Rajashekarappa, New Age International.
3. Fundamentals of Mechanical Engineering by Sawhney, PHI.
4. Engineering Thermodynamics by P. K. Nag, McGraw Hill.

References Books:

1. Engineering Mechanics: Statics and Dynamics by R. C. Hibbler, Pearson.
2. Thermodynamics An Engineering Approach by Cengel & Boles, McGraw Hill.
3. Internal Combustion Engine by V Ganesan, McGraw Hill Pub.
4. An Introduction to Mechanical Engineering by Wickert & Lewis, Cengage Learning.
5. Basic Mechanical Engineering by Pravin Kumar, Pearson.
6. Elements of Mechanical Engineering by Singh, Anne Books Pvt Ltd.

Course Outcome:

After the completion of the course, the student will

- Have a thorough understanding of the concepts of Force, Moment of Inertia etc.
- Know, understand and be able to apply the concept of Thermodynamics
- Be familiar with the working of IC Engines

Subject Expert (Dr. Anand Kumar) HoD/Incharge Dean (Academics) Director

BME 253: Elements of Mechanical Engineering Lab

Subject Code	BME 253					
Category	Basic Engineering Course					
Subject Name	Elements of Mechanical Engineering Lab					
Scheme and Credits	L-T-P	External Practical	Sessional		Total	Credit
			Test	Record &Att.		
	0-0-2	30	15	05	50	1
Pre- requisites (if any)	Knowledge of Intermediate Mathematics of UP Board or equivalent Board.					

List of Experiments:

Note: Any 6 experiments

1. Experiment on Statics equilibrium.
2. Experiment on truss/frame.
3. To verify the polygon law of force.
4. To determine the coefficient of friction on inclined surface.
5. Experiment on moment of inertia.
6. To Study and working of 2 stroke Diesel/Petrol engine.
7. To Study and working of 4 stroke Petrol/Diesel engine.

Course Outcome:

At the end of the Laboratory course, students will be

- Able to understand and experiment with the concepts of Force, Inertia, Friction etc
- Able to understand the working of 2 stroke / 4 stroke petrol/ diesel engine

Subject Expert HoD/Incharge 20.9.18 Dean (Academics) 26.9.18 Director 26.09.2018

EE/ BCE/Sa

BEC 101 - Basic Electronics Engineering

Subject Code	BEC 101/ BEC 201					
Category	Basic Engineering Course					
Subject Name	Basic Electronics Engineering					
Branches	All					
Scheme and Credits	L-T-P	Theory Marks	Sessional		Total	Credit
			Test	Assign/Att.		
	2-0-0	70	20	10	100	2
Pre- requisites (if any)	Knowledge of Intermediate Mathematics of UP Board or equivalent Board.					

Course Objective:

- To introduce Semiconductor Devices, Characteristics & Applications.
- To impart basic knowledge of Operational Amplifier.
- To help acquire thorough understanding of Number Systems and Logic Gates.
- To provide elementary knowledge of Communication Systems.

Course Content:

Unit -1
Semiconductor Diode: Ideal versus Practical, V-I characteristics, Diode Equivalent Circuits, Load Line Analysis, Diode Applications as a Switch, Half Wave and Full Wave Rectifiers. Zener Diode: Operation and Applications, Zener Diodes breakdown mechanism (Zener and Avalanche) Light-Emitting Diode, Photo Diode- Operation, Construction, Characteristics & Applications.
Unit -2
Bipolar Junction Transistor (BJT): Construction, Operation, Amplifying Action, Common Base, Common Emitter and Common Collector Configurations, Operating Point, Biasing of BJT.
Unit -3
Field Effect Transistor (FET): Construction, Characteristics of JFET, Transfer Characteristics, MOSFET-Depletion and Enhancement type, Transfer Characteristics, Introduction to CMOS circuits. Introduction to operational amplifier.

Subject Expert | HoD/Incharge | Dean (Academics) 26.9.18 | Director 26.9.2018

Unit -4
Number Systems: Decimal Number System, Binary Number System, Converting Decimal to Binary, Hexadecimal Number System: Converting Binary to Hexadecimal, Hexadecimal to Binary, Converting Hexadecimal to Decimal, Converting Decimal to Hexadecimal, Octal Numbers: Binary to Octal Conversion. Boolean Algebra Theorems, De Morgan's theorem. Digital Circuits: Logic gates, NOT Gate, AND Gate, OR Gate, Ex-OR Gate, NAND Gate, NOR Gate, Ex-NOR Gate, 1's, 2's & 10's Complement.
Unit -5
Basics of Communication Engineering: Block Diagram of a Communication System, Need of modulation, electromagnetic spectrum and typical applications, terminologies in communication systems, Basics of signal representation and analysis, Fundamentals of Modulation and Demodulation techniques.

Text / Reference Books

1. Robert L. Boylestad &Louis Nashelsky, "Electronic Devices and Circuit Theory", Pearson Education
2. Jacob Millman/ Christos C. Halkias/ Satyabrata Jit "Electronics Devices and Circuits", TMH
3. Salivahanan, N Suresh Kumar, Electronic Devices and circuits, McGraw Hill publications
4. M. Morris Mano and M. D. Ciletti, "Digital Design", Pearson Education
5. Simon Haykin, "Communication Systems", Wiley India Publication
6. B.P.Lathi, "Modern Digital and Analog Communication Systems", Oxford University Press

Course Outcome:

	Course Outcome	Bloom's Knowledge Level
At the successful completion of the course students will be		
CO 1	Able to understand the Characteristics and working of Semiconductor Devices.	K2
CO 2	Able to comprehend the working principle of operational amplifier and its applications.	K3
CO 3	Able to understand Number System and their conversion and Analyze Logic Gates.	K4
CO 4	Familiar with components of Communication Systems and their applications.	K2

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Subject Expert HoD/Incharge Dean (Academics) Director

BEC 151 - Basic Electronics Engineering Lab

Subject Code	BEC 151/ BEC 251					
Category	Basic Engineering Course					
Subject Name	Basic Electronics Engineering Lab					
Scheme and Credits	L-T-P	External Practical	Sessional		Total	Credit
			Test	Record &Att.		
	0-0-2	30	15	05	50	1
Pre- requisites (if any)	Knowledge of Intermediate Mathematics of UP Board or equivalent Board.					

List of Experiments:

1. Study of Multi-meter
2. Study of Cathode Ray Oscilloscope
3. Study of electronic components
4. V-I Characteristics of PN junction diode
5. Zener Diode Characteristics
6. Half wave Rectifier
7. Bridge Rectifier
8. Common Emitter Characteristics
9. Verification of Truth Tables – AND, NAND, NOT, OR, NOR, XOR Gates
10. Op-Amp Characteristics
11. Op-Amp Applications

Course Outcome:

At the end of the Laboratory course, students will be

- Able to use Multi-meter and CRO for measurement
- Familiar with different components in Electronics Lab
- Able to understand the working of diodes and BJT
- Familiar with Op-Amp
- Familiar with Logic gates

Subject Expert HoD/Incharge Dean (Academics) Director

BHSM101/BHSM201 - Professional English

Subject Code	BHSM101 / BHSM201					
Category	Humanities					
Subject Name	Professional English					
Scheme and Credits	L-T-P	Theory Marks	Sessional		Total	Credit
			Test	Assign/Att.		
	2-0-0	60	30	10	100	2
Pre- requisites (if any)	Knowledge of Intermediate Mathematics of UP Board or equivalent Board.					

Course Objectives:

- The course intends to develop the English Language proficiency of the students by focusing on Listening, Speaking, Reading and Writing (LSRW) skills so that they can communicate effectively in real life situations (professional and social life).
- It aims to teach the students about appreciation of English Language, develop their evaluative capacity and critical understanding of any text by improving their reading comprehension skills through their exposure to scientific, creative and academic text.
- The course is designed to enable the students learn different components of effective writing and improve their technical writing skills.
- The students are expected to enrich their listening and speaking abilities through exposure to variety of listening and speaking drills subsequently resulting in an overall developed personality.

UNIT- I

Basics of Communication

- Importance of Technical Communication, Difference b/w Technical & General Communication
- Communication: Types or Levels
- Components and Process of Communication
- Flow of Communication: Vertical, Horizontal, Diagonal
- Verbal and Non Verbal Communication
- Communication Window/ Johari Window
- Barriers to Communication

Subject Expert HoD/Incharge Dean (Academics) Director

Unit- II

Listening and Speaking Skills

- Types of Listening: Appreciative, Empathetic, Comprehensive, Critical, Superficial
- Difference between Hearing and Listening; Barriers to listening
- Basic sounds of English: Vowels and Consonants
- Phonetic Transcription
- Stress: Word Stress, Sentence Stress, Intonation
- Group Discussion, Debate, Oral Presentation, Interview

Unit -III

Reading Skills and its Improvement

- Literary and Non-Literary Text
- Reading Comprehension: Skimming, Scanning, Non Verbal Signals, Author's Viewpoint, Vocabulary Building, Note Making
- Note-Making: Outline, Sentence and Mapping Method
- Reading Literary Text: a) The Rule of the Road by A.G. Gardiner
  b) The Old Man at the Bridge by Ernest Hemingway
  c) An Outline of Intellectual Rubbish by Bertrand Russell

Unit- IV

Writing Skills:

- Elements of Effective Writing
- Precis Writing and Paragraph Writing
- Essentials of Letter Writing: Formal and Informal
- Curriculum Vitae (with Cover Letter)
- Report Writing: News and Magazine Report
- Email and Social Media – Facebook, Twitter, Blog (Elementary Introduction)

Unit- V

Basics of Grammar and its common errors

- Parts of Speech
- Sentence Types: Simple, Compound and Complex
- Sentence: Phrase and Clause
- Voice: Active and Passive
- Vocabulary Enhancement: Synonyms, Antonyms, Idioms, One Word Substitution, Homophone, Homonym, Affixes, Contextual Word Meaning (Connotation and Denotation)
- Common Errors in English/ Correction of Sentences (Exercises)

Reference Books-

1. Technical Communication- By Meenakshi Raman, OUP.
2. Effective Technical Communication, Rizvi, TMH
3. Communication Skills for Engineers, Pearson Education
4. Effective Business Communication, Tat McGraw Hill
5. Practical English Grammar by Thomas Martinet, Oxford University Press
6. A textbook of English Phonetics for Indian students by T. Balasubramanian.
7. Wren & Martin's High School English Grammar & Composition
8. Sinha, R.P. Current English Grammar and Usage. OUP, 2017

Course Outcomes:

CO1	Speak fluently, effectively and clearly in a public forum to a variety of audiences and purposes	K3
CO2	Prepare and Deliver effective oral presentations, arguments, research paper writing, administrative Communication acceptable within the professional fields	K3
CO3	Critical, analytical and thorough readings of various texts to demonstrate in writing or speech of an enriched and comprehensive interpretation of those texts	K4
CO4	Acquaintance and familiarity with various dimensions of communication skills i.e. Listening, Speaking, Reading and Writing	K2
CO5	Evaluate and interpret text written in English, error free writing and speech by being well versed in English Grammar and cultivating good technical communication skills	K5
CO6	Developing personality, confidence and raising work ethics including those necessary for collaboration and cooperation with others	K6

K1: Remember	K3: Apply	K5: Evaluate
K2: Understand	K4: Analyze	K6: Create

Subject Expert HoD/Incharge Dean (Academics) Director

BHSM151/BHSM251: Professional English Laboratory

Subject Code	BHSM151/BHSM251					
Category	Humanities					
Subject Name	Professional English Laboratory					
Scheme and Credits	L-T-P	External Practical	Sessional		Total	Credit
			Test	Record &Att.		
	0-0-2	30	15	05	50	1
Pre- requisites (if any)	Knowledge of Intermediate Mathematics of UP Board or equivalent Board.					

Course Objectives: The objective of language lab is to involve and train students in variety of listening and speaking activities which would help students in building their confidence and personality by enhancing their communication skills. It will also prepare them for interviews and competitive examinations which would benefit them in achieving their career goals.

List of Experiments:

Oral Communication: (i) Listening Skills (ii) Speaking Skills
(This involves interactive practice sessions in Language Lab)

- Listening Comprehension
- Phonetic Symbols
- Pronunciation, Intonation, Stress and Rhythm
- Common Everyday Situations: Conversations and Dialogues (Telephonic and Face to face Communication)
- Formal Communication
  - Communication at Workplace
  - Interviews
  - Oral Presentations

Course Outcome:

The student will acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills.

Subject Expert HoD/Incharge Dean (Academics) Director

Institute of Engineering & Technology
Khandari Campus, Agra

BACHELOR OF ENGINEERING (B.E.) DEGREE

Course Structure & Evaluation Scheme

Approved for 3rd, 4th Year only

(Civil Engineering)

w.e.f. 2020-21

Dr. Bhimrao Ambedkar University, Agra - 282002
(Formerly Agra University, Agra)
www.dbrau.org.in

BACHELOR OF ENGINEERING (CIVIL ENGINEERING)

General, Course structure & Theme
&
Semester-wise credit distribution

A. Definition of Credit:

1 Hr. Lecture (L) per week	1 credit
1 Hr. Tutorial (T) per week	1 credit
1 Hr. Practical (P) per week 2 Hours Practical (Lab)/week	0.5 credits 1 credit

B. Structure of Undergraduate Engineering program:

S. No.	Category	Suggested Breakup of Credits (Total 160)
1.	Basic Science Courses (BSC)	20
2.	Engineering Science Courses (ESC)	30
3.	Humanities, Social Science and Management Courses (HSMC)	10
4.	Professional Core Courses (PCC)	60
5.	Professional Elective Courses (PEC)	18
6.	Open Elective Courses (OE-ME)	14
7.	Seminar	2
8.	Project	10
9.	Internships in industry	8
10.	Mandatory Courses (MC)	NC
	Total Credits	172

C. Course code and definition:

Course code	**Definitions**
BSC	Basic Science Courses
ESC	Engineering Science Courses
HSMC	Humanities and Social Sciences including Management courses
PCC	Professional core courses
PEC	Professional Elective courses
OE-ME	Open Elective courses
LC	Laboratory course
MC	Mandatory courses

**Minor variation is allowed as per need of the respective disciplines.*

Civil Engineering

Table Structure of B.E. Program

S. No.	COURSES/SEMESTER	Total Credits	Credits							Actual Credits
			I & II	III	IV	V	VI	VII	VIII	
1.	Basic Science Courses(BSC)	20	17	4						21
2.	Engineering Science Courses(ESC)	30	19	9						28
3.	Humanities, Social Science and Management Courses(HSMC)	10	4		4		2			10
4.	Professional Core Courses(PCC)	60		8	17	14	13	6	7	62
5.	Professional Elective Courses(PEC)	18				6	4	4	4	18
6.	Open Elective Courses(OE-ME)	14				3	3	4	4	14
7.	Seminar	2						2		2
8.	Project	10						3	7	10
9.	Internship in Industry	8		2		3		2		7
10.	Mandatory Courses(MC)	NC								
	Total credits	172	40	21	23	23	21	22	22	172

S No.	Code	Subject	Periods			Sessional Marks			End Semester Marks			Credit
			L	T	P	CT	TA	Total	TE	PE	Total	
1	BSC101 OR BSC102	Physics (Gr – A) OR Chemistry (Gr - B)	3	1	0	30	10	40	60		100	4
2	BSC103	Mathematics-I (All Branches)	3	1	0	30	10	40	60		100	4
3	BCS101 OR BEE101	Problem Solving and Computer Programming using "C" (Gr – A) OR Fundamentals of Electrical Engineering (Gr – B)	3	1	0	30	10	40	60		100	4
4	BME101 OR BME102	Engineering Graphics & Design (Gr – A) OR Workshop Concepts (Gr – B)	2	0	0	30	10	40	60		100	2
5	BEC 101 OR BHSM101	Basic Electronics Engineering (Gr - A) Professional English (Gr – B)	2	0	0	30	10	40	60		100	2
6	BSC151 OR BSC152	Physics Lab OR Chemistry Lab	0	0	2	15	05	20	-	30	50	1
7	BCS151 OR BEE151	Computer Programming Lab OR Electrical Engineering Lab	0	0	2	15	05	20		30	50	1
8	BME151 OR BME152	Engineering Graphics & Design Lab OR Workshop Concept Lab	0	0	2	15	05	20		30	50	1
9	BEC 151 OR BHSM151	Basic Electronics Engineering Lab OR Professional English Lab	0	0	2	15	05	20	-	30	50	1
10	MC	Induction training										
		Total	13	3	8	210	70	280	300	120	700	20

Group – A (CSE/ECE/EE) **Group – B (CE/ME)**

B.E I Year (Semester-II) All Branches

Choice Based Credit System (Scheme of Studies & Examinations)

S No.	Code	Subject	Periods			Sessional Marks			End Semester Marks			Credit
			L	T	P	CT	TA	Total	TE	PE	Total	
1	BSC 202 OR BSC 201	Chemistry (Gr – A) OR Physics (Gr – B)	3	1	0	30	10	40	60		100	4
2	BSC 203	Mathematics-II (All Branches)	3	1	0	30	10	40	60		100	4
3	BEE 201 OR BCS 201	Fundamentals of Electrical Engineering (Gr – A) OR Problem Solving and Computer Programming using "C" (Gr – B)	3	1	0	30	10	40	60		100	4
4	BME 202 OR BME 201	Workshop Concepts (Gr – A) OR Engineering Graphics & Design (Gr – B)	2	0	0	30	10	40	60		100	2
5	BHSM 201 OR BME 203	Professional English (Gr – A) OR Elements of Mechanical Engineering (Gr B)	2	0	0	30	10	40	60		100	2
7	BSC252 OR BSC251	Chemistry Lab OR Physics Lab	0	0	2	15	05	20	-	30	50	1
8	BEE251 OR BCS251	Electrical Engineering Lab OR Computer Programming Lab	0	0	2	15	05	20		30	50	1
9	BME252 OR BME251	Workshop Concept Lab OR Engineering Graphics & Design Lab	0	0	2	15	05	20		30	50	1
10	BHSM251 OR BME253	Professional English Lab (Gr A) OR Elements of Mechanical Engineering lab (Gr B)	0	0	2	15	05	20	-	30	50	1
		Total	15	3	10	255	85	340	360	150	750	20

Group – A (CSE/ECE/EE) **Group – B (CE/ME)**

B.E II Year (Semester-III) Civil Engineering
Course Structure & Evaluation Scheme

S No.	Course Category	Course Code	Course Title	Periods/Week			Sessional Marks			End Semester Marks			Credit
				L	T	P	CT	TA	Total	TE	PE	Total	
1	BSC	BSC 301	Mathematics -III	3	1	-	30	10	40	60	-	100	4
2	ESC	ESC 301	Strength of Material	3	0	-	30	10	40	60	-	100	3
3	ESC	ESC 302	Building Material & Construction	3	1	-	30	10	40	60	-	100	4
4	PCC	BCE 301	Surveying	3	1	-	30	10	40	60	-	100	4
5	PCC	BCE 302	Water Resources Engineering	3	0	0	30	10	40	60	-	100	3
6	MC	MC 301	Environment & Ecology	2	0	0	30	10	40	60	-	100	0
7	ESC	ESC 351	Building Material & Construction Lab	-	-	2	20	20	40	-	60	100	1
8	PCC	BCE 352	Surveying Lab	-	-	2	20	20	40	-	60	100	1
9	ESC	ESC 353	Strength of Material Lab	-	-	2	20	20	40	-	60	100	1
10	Project/Internship	ESC 353	Mini Project/Internship	-	-	4	-	-	100	-	-	100	2
			Total	17	3	10	240	120	460	240	180	1000	23

* The mini project or Internship (3-4 weeks) conducted during summer break after II semester & will be assessed during III semester.

CT: Class Test, TA: Teacher's Assessment, TE: Theory Exam, PE: Practical Exam

Dean(Academics) **Director**

B.E II Year (Semester-IV) Civil Engineering
Course Structure & Evaluation Scheme

S No.	Course Category	Course Code	Course Title	Periods/Week			Sessional Marks			End Semester Marks			Credit
				L	T	P	CT	TA	Total	TE	PE	Total	
1	PCC	BCE 401	Fluid Mechanics	3	1	-	30	10	40	60	-	100	4
2	HSMC	HSMC 401	Disaster Management	2	0	-	30	10	40	60	-	100	2
3	PCC	BCE 402	Structural Analysis-I	3	1	-	30	10	40	60	-	100	4
4	PCC	BCE 403	Estimating & Costing	2	2	-	30	10	40	60	-	100	4
5	PCC	BCE 404	Geotechnical Engineering	3	-	-	30	10	40	60	-	100	3
6	HSMC	HSMC 402	Technical writing and communication	2	-	-	30	10	40	60	-	100	2
7	MC	MC 401	Human Value and Professional Ethics	3	-	-	30	10	40	60	-	100	0
8	PCC	BCE 451	Fluid Mechanics Lab	-	-	2	20	20	40	-	60	100	1
9	PCC	BCE 454	Geotechnical Engineering Lab	-	-	2	20	20	40	-	60	100	1
			Total	18	4	4	250	110	360	360	120	900	21

B.E III Year (Semester-V) Civil Engineering
Course Structure & Evaluation Scheme w.e.f. 2020-21

S No.	Course Category	Course Code	Course Title	Periods/Week			Sessional Marks			End Semester Marks			Credit
				L	T	P	CT	TA	Total	TE	PE	Total	
1	PCC	BCE 501	Environmental Engineering	3	1	-	30	10	40	60	-	100	4
2	PCC	BCE 502	Engineering Geology	3	0	-	30	10	40	60	-	100	3
3	PCC	BCE 503	Structural Analysis-II	3	1	-	30	10	40	60	-	100	4
4	PEC	DE-CE 501-505	Departmental Elective – I	3	0	-	30	10	40	60	-	100	3
5	OEC	OEC	Open Elective - I	3	0	-	30	10	40	60	-	100	3
6	MC	MC 501	Occupational Health & Safety	2	0	-	30	10	40	60	-	100	0
7	LC	BCE 551	Environmental Engineering Lab	-	-	2	20	20	40	-	60	100	1
8	LC	BCE 552	Engineering Geology Lab	-	-	2	20	20	40	-	60	100	1
9	LC	BCE 553	Structural Analysis-II Lab	-	-	2	20	20	40	-	60	100	1
10	Internship	BCE 554	Internship	-	-	4	-	-	40	-	60	100	2
			Total	15	02	10	210	110	360	300	240	900	22

INDUSTRIAL INTERNSHIP (BCE 554): The students shall have to undergo a 4 week practical training (Industrial Internship) at the end of fourth semester. The evaluation of this would be made in 5th semester. This evaluation shall be based on presentation of Training report and viva.

B.E III Year (Semester-VI) Civil Engineering

Course Structure & Evaluation Scheme w.e.f. 2020-21

S No.	Course Category	Course Code	Course Title	Periods/Week			Sessional Marks			End Semester Marks			Credit
				L	T	P	CT	TA	Total	TE	PE	Total	
1	HSMC	HSMC601	Economics For Industry	2	0	0	30	10	40	60	-	100	2
2	PCC	BCE 601	Hydraulic & Hydraulic Machines	3	1	-	30	10	40	60	-	100	4
3	PCC	BCE 602	Transportation Engineering	3	1	-	30	10	40	60	-	100	4
4	PEC	DE-CE 601-605	Departmental Elective – II	3	1	-	30	10	40	60	-	100	4
5	OEC	OEC	Open Elective – II	3	0	-	30	10	40	60	-	100	3
6	LC	BCE 651	Hydraulic & Hydraulic Machines Lab	-	-	2	20	20	40	-	60	100	1
7	LC	BCE 652	Transportation Engineering Lab	-	-	2	20	20	40	-	60	100	1
8	LC	BCE 653	CAD Lab	-	-	6	20	20	40	-	60	100	3
			Total	14	03	10	210	110	320	300	180	800	22

B.E IV Year (Semester-VII) Civil Engineering
Course Structure & Evaluation Scheme w.e.f. 2021-22

S No.	Course Category	Course Code	Course Title	Periods/Week			Sessional Marks			End Semester Marks			Credit
				L	T	P	CT	TA	Total	TE	PE	Total	
1	**PCC**	**BCE 701**	Construction Planning & Management	**3**	**0**	**-**	**30**	**10**	**40**	**60**	**-**	**100**	**3**
2	**PCC**	**BCE 702**	Design of Concrete Structure	**3**	**1**	**-**	**30**	**10**	**40**	**60**	**-**	**100**	**4**
3	**PEC**	**DE-CE 701-705**	Departmental Elective-III	**3**	**0**	**-**	**30**	**10**	**40**	**60**	**-**	**100**	**3**
4	**OEC**	**OEC**	Open Elective- III	**3**	**1**	**-**	**30**	**10**	**40**	**60**	**-**	**100**	**4**
5	**Project/Internship**	**BCE 751**	Internship	**0**	**0**	**6**	**20**	**20**	**40**	**-**	**60**	**100**	**3**
6	**Seminar**	**BCE 752**	Seminar	**0**	**0**	**4**	**20**	**20**	**40**	**-**	**60**	**100**	**2**
7	**Project/Internship**	**BCE 753**	Minor Project	**0**	**0**	**6**	**-**	**100**	**100**	**-**	**-**	**100**	**3**
			Total	**12**	**03**	**16**	**140**	**180**	**340**	**240**	**120**	**700**	**22**

INDUSTRIAL INTERNSHIP (BCE 753) The students shall have to undergo a 4 week practical training (Industrial Internship) at the end of sixth semester. The evaluation of this would be made in 7th semester. This evaluation shall be based on presentation of Training report and viva.

SEMINAR (BCE 752) Individuals have to select topic of current interest, Review and Evaluate available Literature & present the content in own Language and style.

B.E IV Year (Semester-VIII) Engineering

Course Structure & Evaluation Scheme w.e.f. 2021-22

S No.	Course Category	Course Code	Course Title	Periods/Week			Sessional Marks			End Semester Marks			Credit
				L	T	P	CT	TA	Total	TE	PE	Total	
1	PCC	BCE 801	Design of Steel Structure	3	0	-	30	10	40	60	-	100	3
2	PEC	DE-CE 801-805	Departmental Elective IV	3	1	-	30	10	40	60	-	100	4
3	PEC	DE-CE 806-810	Department Elective-V	3	1	-	30	10	40	60	-	100	4
4	OEC	OEC	Open Elective-IV	3	1	-	30	10	40	60	-	100	4
5	Project/Internship	BCE 851	INDUSTRIAL BASED PROJECT	0	0	14	-	100	100	-	200	300	7
			Total	12	03	14	120	140	260	240	200	700	22

PROJECT (BCE 851) The B.E. project shall be spread over two semesters (7th and 8th). The details about group formation, allotment of topics shall be done as per the Institute‘s guidelines available on the website.

List of Departmental Electives

Departmental Elective – I

1. DE-CE 501 Design of Wastewater Treatment Systems
2. DE-CE 502 Water Quality Modeling
3. DE-CE 503 Plastic Analysis of Structures
4. DE-CE 504 Structural Fire Engineering
5. DE-CE 505 Engineering Hydrology & Floods

Departmental Elective – II

1. DE-CE 601 Planning and Management of Building
2. DE-CE 602 Wind and Seismic Analysis
3. DE-CE 603 Rural Water Supply
4. DE-CE 604 Computer Aided Structural Engineering
5. DE-CE 605 Geo - Environmental and Geo - Hazard Engineering

Departmental Elective – III

1. DE-CE 701 Pre-Stressed Concrete Design
2. DE-CE 702 Analysis & Design of Hydraulic Structure
3. DE-CE 703 Transportation System and Planning
4. DE-CE 704 Bridge Engineering
5. DE-CE 705 Soil Dynamics

Departmental Elective – IV

1. DE-CE 801 Advanced Hydrology
2. DE-CE 802 Open Channel and River Hydraulics
3. DE-CE 803 Ground Water Management
4. DE-CE 804 Design of Masonry, Timber and Aluminum Structure
5. DE-CE 805 Matrix Method of Structural Analysis

Departmental Elective – V

1. DE-CE 806 Advanced Concrete Technology
2. DE-CE 807 Solid Waste Management
3. DE-CE 808 Docks & Harbor Engineering
4. DE-CE 809 Industrial Pollution Control and Environmental Audit
5. DE-CE 810 Earthquake Resistant Design Systems

List of Open Electives		
Open Elective – I		
1.	OE-CE 501	Environmental Pollution and Management
2.	OE-CE 502	Urban and Town Planning
3.	OE-EC 501	Laser System and its Application
4.	OE-EC 502	Bio- Medical Engineering
5.	OE-ME 501	Industrial Engineering & Automation
6.	OE-ME 502	Total Quality Management
7.	OE-ME 503	Production Planning and Control
8.	OE-ME 504	Value Engineering
9.	OE-CS 501	Operation Research
11.	OE-CS 502	Graph Theory
12.	OE-CS 503	Computer Based Numerical and Statistical Techniques
13.	OE-EE 501	VLSI Circuits
Open Elective – II		
1.	OE-CE 601	Water Resources Conservation
2.	OE-CE 602	Environmental Management
3.	OE-EC 601	Robotics
4.	OE-EC 602	Mechatronics
5.	OE-ME 601	Composite Materials
6.	OE-ME 602	Entrepreneurship
7.	OE-ME 603	Mechanical System Design
8.	OE-ME 604	Product Development & Design
9.	OE-CS 601	Modeling And Simulation
10.	OE-CS 602	Internet of Things
11.	OE-EE 601	Electrical and Hybrid Vehicles
12.	OE-EE 602	Nanoelectronics
Open Elective – III		
1.	OE-CE 701	Finite Element Analysis

2.	OE- CE 702	Environment Impact Assessment
3.	OE-EC 701	Digital System Design using VHDL
4.	OE-EC 702	Micro Electro Mechanical System
5.	OE-ME 701	Non-Conventional Energy Resources
6.	OE-ME 702	Nanotechnology
7.	OE-ME 703	Non-Destructive Evaluation
8.	OE-ME 704	Introduction to Mechanical Micro Machining
9.	OE-CS 701	Data Science
10.	OE-CS 702	Big Data Analytics
11.	OE-CS 703	Artificial Intelligence
12.	OE-EE 701	Machine learning and Python Programming
13.	OE-EE 702	Embedded Systems
Open Elective – IV		
1.	OE-CE 801	Remote Sensing And Geographic Information System
2.	OE-CE 802	Infrastructure Engineering
3.	OE-EC 803	Structural Dynamics
4.	OE-EC 801	Advance Sensors and Transducer
5.	OE-EC 802	Multimedia Communication
6.	OE-ME 801	Power Plant Engineering
7.	OE-ME 802	Optimization Methods in Engineering
8.	OE-ME 803	Fracture Mechanics
9.	OE-ME 804	Machine Tool Design
10.	OE-CS 801	Block chain
11.	OE-CS 802	Computer Vision
12.	OE-EE 801	Metro Systems and Engineering
13.	OE-EE 802	Speech and Audio Processing

PROGRAMME OUTCOMES FOR B.TECH. (CIVIL ENGINEERING)

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

Engineering Graduates will be able to:

1. Plan, analyse, and design infrastructural projects and its components in various areas of Civil Engineering like Structural Engineering, Geotechnical Engineering, Water Resources Engineering, Environmental Engineering, and Transportation Engineering.

2. Execute the construction of buildings and other components of various projects in Civil Engineering including its layout, management, and quality control.

3. Implement the provisions made in Indian Standard Codes/ other relevant codes/ specifications/ guidelines and applicable laws including labour laws and environmental laws.

Syllabus of

UNDERGRADUATE DEGREE COURSE

Bachelor of Engineering

III Semester

Civil Engineering

Institute of Engineering & Technology, Khandari Campus

Dr. B R Ambedkar University, Agra

Effective from session: 2019-20

MATHEMATICS-III

COURSE CODE: BSC-301

III SEMESTER (ECE, CSE, EE, ME, CE)

	L T P C
Course Details:	**3 1 0 4**

Course Outcomes:

Upon successful completion of this course, students will be able to:

1. Solve the Fourier Transform of function.
2. Compute poles & zeros.
3. Evaluate the real & complex integrals with the help of Cauchy's Residue Theorem.
4. Utilize curve fitting techniques for data representations and computation in engineering analysis.
5. Use Binomial, Poisson & Normal Distribution to solve statistical problems.

Unit – I:

Fourier Transform :

Fourier integral, conditions of convergence, Fourier sine and cosine integrals, complex form, applications, Inversion formula for Fourier transform, operational properties. Discrete and Fast Fourier transform. Applications of Fourier transform to solve boundary value problems.

Unit- II:

Functions of a Complex Variable and Conformal mapping:

Limit, Continuity, Differentiability and Analyticity of functions of a complex variable, Cauchy-Riemann equations, Harmonic functions, Complex functions as mappings, Linear Transformation, Inverse transformation, Bilinear Transformations, Conformal Mapping & applications.

Unit- III:

Integration of Complex Functions:

Contour integrals and evaluations, Cauchy's Theorem, Cauchy's Integral Formulae, Liouville's theorem, Convergence of power series, Taylor series, Laurent series, Zeros and Singularities of a complex function, Residues and Residue theorem, Evaluation of definite and improper integrals.

Unit- IV:

Curve- Fitting & Probability:

Curve-fitting: method of least- squares, Normal equations, Normal equation in case of straight line, Fitting a straight line, Polynomial, non-linear and exponential curves, Change of origin. Probability: Basics of probability, random variables, Expectation, Baye's theorem and probability distributions, Binomial, Poisson and Normal distributions.

Unit- V:

Statistical Methods:

Sampling Theory, Parameters of Statistics, Tests of hypothesis and significance, z-test, t-test, $\chi 2$- test ,Goodness of fit test, Time series analysis, Index numbers, Quality control chart and acceptance sampling, Introduction to design of experiments, Forecasting models.

Books Recommended:

1. R.K. Jain & S.R.K. Iyengar; Advanced Engineering Mathematics, Narosa Publishing House, 2002.

2. Erwin Kreyszig; Advanced Engineering Mathematics, John Wiley & Sons, 1962.
3. R.V. Churchill and J.L. Brown, Complex Variables and Applications, McGraw Hill, 1990.
4. B.S.Grewal, Higher Engineering Mathematics, Khanna Publisher, 2005.
5. J.H. Mathews and R.W. Howell, Complex analysis for Mathematics and Engineering, 3rd Ed. Narosa, 1998.

Course Objective :

1. Fourier transform is useful in study of frequency response of filter, In the theories of communication engineering, wave propagation, transmission lines and solution of boundary value problems. Discrete and fast fourier transform are used in signal analysis. Fourier transform is also used in electromagnetic field, medical application and in error control coding. Discrete analysis playes an important role in the development of communication engineering.
2. Complex Analysis is the study of analytic functions. It is an elegant and powerful method useful in the study of heat flow, fluid dynamics and electrostatics. Two-dimensional potential problem can be solved using analytic functions.
3. The other important applications of this theory is to evaluate many real integrals which can not be evaluated by usual methods.
4. In many engineering problems to establish a linear, quadratic, cubic or exponential relationship between two quantities, it is required two or more unknowns in such a way that these follow whole data, such situations occur in the problems of curve fitting etc.
5. In analyzing and interpreting data probability theory involves an element of "chance" or uncertainty, probability theory plays a vital role in the theory and application of statistics. Probability distribution is the theoretical counterpart of frequency distribution and plays an important role in the theoretical study of populations

STRENGTH OF MATERIALS (ESC-301) L T P C 3 0 0 3

Prerequisite: Students must have knowledge of engineering mechanics engineering basic application

Course Outcomes:

Upon successful completion of this course, students will be able to:

CO1 To understand the nature of stresses induced in material under a different loading such as compression, tension, shear, bending. And understand the curved beam and analysis the curved beam on different cross section

CO2 To evaluate the stress in beam subjected to unsymetrical bending and find the shear Centre for different cross section.

CO3 Draw the shear force and bending moment diagrams for the beam subjected to different loading condition. Evaluate the deflections in beams subjected to different loading conditions.Analysis the hellical and leaf spring on open and closed coil condition

CO4 To understand the basic concept of combined and direct bending stress analysis and design of structural elements such as columns and strut.

CO5 Analysis the tihck and thin cylindrical

Course Content:

Unit I

Stresses in Beams: Review of pure Bending**.** Direct and shear stresses in beams due to transverse and axial

loads, composite beams.

Curved Beams: Bending of beams with large initial curvature, position of neutral axis for rectangular, trapezoidal and circular cross sections, stress in crane hooks, stress in circular rings subjected to tension or compression.

Unit II

Unsymmetrical Bending: Properties of beam cross-section, slope of neutral axis, stress and deflection in unsymmetrical bending, determination of shear center and flexural axis (for symmetry about both axis and about one axis) for I-section and channel section.

Deflection of Beams: Shear Force and Bending Moment Diagram, Flexuralrigitidit**,** Equation of elastic curve, cantilever and simply supported beams, Macaulay's method, area moment method Fixed beams. Castigliano‘s Theorem

Unit III

Helical and Leaf Springs: deflection of springs by energy method, helical springs under axial load and under axial twist (respectively for circular and square cross sections) axial load and twisting moment acting simultaneously both for open and closed coiled springs, laminated springs.

Unit IV

Columns and Struts: Combined bending and direct stress, middle third and middle quarter rules. Struts with different end conditions. Euler‘s theory and experimental results, Ranking Gardon Formulae, Examples of columns in mechanical equipments and machines.

Unit V

Thin cylinders & spheres: Hoop and axial stresses and strain. Volumetric strain.

Thick cylinders: Radial, axial and circumferential stresses in thick cylinders subjected to internal or external pressures, Compound cylinders Stresses due to interference fits.

Text and Reference Books:

1. Engineering Mechanics by R.K.Bansal 2. Strength of Materials by R.K. Rajput **Reference books:**
2. Engineering Mechanics by Irving H. Shames, Prentice-Hall
3. Mechanics of Materials by E.P.Popov, PHI
4. Strength of Materials by Ryder
5. Mechanics of Material by Gere & Timoshenko
6. Engineering Mechanics by A. Nelson
7. Engineering Mechanics by U.C. Jindal
8. Engineering Mechanics Statics by J.L. Meriam & L.G.Kraige

BUILDING MATERIALS & CONSTRUCTION (ESC 302)

L T P C 3 1 0 4

Course Outcomes:

Upon successful completion of this course, students will be able to:

CO1 Build knowledge to categorize materials associated with building constructions and their related quality, durability and development.
CO2 Understand the properties and manufacturing process of bricks and composition of cement and concrete.
CO3 Appreciate the importance of detection of defects in timber along with timber preservation method.
CO4 Analyze the factors affecting building construction and different component of building.
CO5 Imply different techniques of building construction as per requirement.
CO6 Impart knowledge of various types of properties, uses, and variety of materials important in construction.

Unit-I

Building Materials: Bricks, Stone, Lime, Timber, Plastics & Glass

Introduction: Materials and types, properties of engineering materials, selection of materials, standard.

Bricks: Classification, manufacture, properties and selection criteria of burnt clay bricks, tests for bricks.

Stone: Classification, characteristics of good building stone, common building stones in India.

Lime: IS specifications, field tests of limes.

Timber: Characteristics of good timber, defects, seasoning, tests on timber, plywood. Plastics: Types, properties and uses.

Glass: Types and uses

Unit-II

Building Materials: Cement, Admixtures, Aggregate& Mortar

Cement: Manufacture of cement, types of cement – ordinary Portland cement, Portland pozzolana cement, high alumina cement, sulphate resisting, Portland cement, their

characteristics, composition, use and properties, tests on cements

Admixtures: Mineral admixtures, chemical admixtures

Aggregates: Classification, source, physical and mechanical properties, testing of aggregates

Mortar: Types, classification and strength, I.S. specifications

Modern Building Materials

Unit-III

Building Construction: Masonry Works &Building Byelaws

Building bye-laws: Classification of buildings, recommendations of NBC, Building byelaws, modular coordination-orientation of buildings, desirable conditions of comforts, components of building, area considerations

Masonry: Brick masonry, stone masonry, types of walls, partition and cavity walls, prefabricated construction, plastering and pointing, damp proofing materials and techniques

Unit-IV

Building Construction: Foundation, Floor, Roof, Stairs, Lifts and Escalators

Foundation: Types of foundation and selection criteria

Floor : Types of floors, construction details and selection criteria

Roofs : Types of roofs and roof covering, shuttering, scaffolding and centering

Stairs : Types of stairs, materials, proportions

Lifts and escalators: Utilities and types

Unit-V

Building Construction: Doors, Windows, Finishes & Building Protections

Doors and windows: Types, sizes, purpose of doors and windows Finishes: White washing, colour washing,

painting, distempering

Protections: Fire protection, acoustics and sound insulation, expansion and construction joints, anti-termite treatment, roof treatment for water proofing.

BUILDING MATERIALS & CONSTRUCTION LAB (ESC 351)

LTPC 0 0 2 1

List of Experiments

1. Cement

- Normal consistency of cement
- Initial & final setting time of cement
- Compressive strength of cement
- Fineness of cement
- Soundness of cement

2. Coarse Aggregate

- Sieve analysis of aggregate
- Water absorption of aggregate
- Specific gravity and bulk density of aggregate
- Crushing value of aggregate
- Impact value of aggregate

3. Fine Aggregate

- Sieve analysis of sand
- Silt content of sand
- Bulking of sand

4. Bricks

- Water absorption
- Dimensional tolerances

- Compressive strength
- Efflorescence

5. Physical and mechanical properties of reinforcing steel

References:

1. Arora, S.P. &Bindra, S. P., _A text book of building construction‖, Dhanpat Rai & Sons, Delhi.
2. Jha, J. & Sinha, S.K., —Building construction‖, Khanna Publishers, Delhi.
3. Kulkami, C.J., —A text book of engineering materials‖, Ahmedabad book Depot, Ahmedabad.
4. Kulkami, C. J., —A text book of engineering construction‖, Ahmedabad Book Depot, Ahmedabad.
5. Kumar, S., —Engineering materials‖, Standard Publishers Distributors, Delhi.
6. Kumar, S., —Building construction‖, Standard Publishers Distributors, Delhi.
7. McKay W.B., —Building construction‖, Vol.1 to 4, Orient Longman Ltd, Delhi.
8. Punmia, B.C.,—A text book of building construction‖, Laxmi Publications, Delhi, Madras.
9. Singh, S., —Engineering materials‖, Konark Publishers Pvt. Ltd.
10. Civil engineering materials‖, TTTI Chandigarh, Tata McGraw- New Delhi.
Somayaji, S., —Civil engineering materials‖ Pearson, New Delhi.

SURVEYING-I (BCE 301)

L T P C 3 1 0 4

Course Outcomes:
Upon successful completion of this course, students will be able to:

CO1 Understand the working principles of survey instruments

CO2 Identify data collection methods, prepare field notes and maps.

CO3 Measure the horizontal distances, difference in elevations, draw and use contour plots

CO4 Calculate angles, distances and levels.

CO5 Assess errors and apply corrections

Unit-I Introduction

Importance of surveying to engineers —Examples from different fields; Plane and Geodetic Surveying, Classification of surveys, Methods of locating a point, Sources of error, Types of errors, Principle of working from whole to part.

Measurement of Distances

Measurement by chain and tape. Sources of errors and precautions, Corrections to tape measurements, Field problems, Introduction of modem trends: EDM and Total Stations.

Unit-II

Measurements of Angles and Directions

Compass Surveying: Reference meridians**,** Bearing and azimuths, Magnetic declination and its variations, Use and adjustment of compass.

Theodolite Surveying: Vernier theodolite, micro-optic and electronic theodolites, Temporary and permanent adjustments, Measurement of horizontal and vertical angles Permanent adjustments.

Unit-III Traversing

Principles of traversing by compass and theodolite, Field work and checks, Computation of coordinates, Sources of errors, Precision of traversing, Checking and adjusting of traverse, Omitted measurements, Gale's traverse table.

Tacheometry

Definitions, Principles of stadia systems, Instrument constants, Subtense and tangential systems, Construction and use of Reduction Tacheometers, Errors and Precision.

Unit IV

PlaneTable Surveying

Principle, Advantages and disadvantages, Plane Table equipments, Use of telescopic alidade and self reducing alidades, Different methods of Plane Table Surveying, Resectioning -Two and three point problems, Advantages and disadvantages of Plane Table surveying.

Unit-V

Measurements of Elevation and Contouring

Different methods of determining elevation; Spirit levelling: Definition of terms, principle, Level parts, Temporary and permanent adjustments of levels. Automatic levels, various Levelfing staffs, Methods of spirit levelling, Booking and reduction of fields notes, Curvature and refraction, Reciprocal leveling, Construction and field use of altimeter, Trigonometric levelling-simple and reciprocal observations, Sources of errors and precision of levelling procedures. Definition and characteristics of contours, Use of contour maps, Direct and Indirect methods of contouring.

SURVEYING-I LAB (BCE -352) **L T P C 0 0 2 1**

List of Experiments

1. To study instruments used in chain surveying and to measure distance between two points by ranging.
2. To determine the bearing of sides of a given traverse using Prismatic Compass and plotting of the traverse.
3. To plot details using radiation and intersection methods in plane tabling.
4. To solve two point and three point problem in plane table.
5. To find out the reduced levels of given points using level. (Reduction by Height of collimation method and Rise and fall method).

6. To determine and draw the longitudinal and cross-section profiles along a given route.
7. Practice for temporary adjustments of a Vernier Theodolite and taking Horizontal and Vertical angular measurements, by Reiteration method.
8. Measurement of horizontal using Theodolite angles by Repetition method.
9. Determination of the Tacheometric constants of a given theodilite.

References :

1. Agor, R. ―Surveying‖, Vol. I & II, Khanna Publications, Delhi,
2. Arora, K.R., ―Surveying‖, Vol. I & II, Standard Book House, Delhi,
3. Bannister, A. and Baker, R., ―Solving Problems in Surveying‖, Lorigman Scientific Technical, U.K., 1994.
4. Kennie, T.J.M. and Petrie, G., ―Engineering Surveying Technology‖, Blackie & Sons Ltd., London, 1990.
5. Punmia, B.C., ―Surveying‖, Vol. I & II, Laxmi Publications New Delhi,
6. Duggal, S.K., ―Surveying‖, Vol. I & II, TMH Education
7. Basak, ―Surveying‖ TMH Education.
8. Kanetkar, ―Surveying‖, Vol.1, II. Pune Vidyarthi Griha Prakashan
9. Chandra, A.M. ―Plane Surveying‖, New Age International Publishers, Delhi
10. Chandra, A.M. ―Higher Surveying‖, New Age International Publishers, Delhi

BCE – 302 WATER RESOURCES ENGINEERING

L T P C 3-0-0-3

Course Outcomes:

Upon successful completion of this course, students will be able to:

CO1 Develop the basic knowledge of hydrologic cycle, precipitation, evaporation, evapo-transpiration, infiltration process.

CO2 Demonstrate the stream flow measurement.

CO3 Apply fundamental concept of mathematics to obtain hydrograph characteristics.

CO4 Develop the basic knowledge of types of irrigation systems, methods of irrigation, water requirement of crops, design of unlined alluvial channels by silt theories with canal irrigation.

CO5 Understand solution regarding water logging and drainage.

UNIT – I

Hydrology : Hydrologic Cycle. Water Budget Equation, Hydrologic system, Precipitation : Types, measurements and analysis, error in estimation, missing data,

consistency of rainfall records, Intensity during frequency (IDF) and probabilitic maximum Precipitation (PMP) curves.

Evaporation and consumptive use: Process affecting factors, estimation and measurement techniques. Infiltration : Process affecting factors, measurement and estimation, Infiltration Indices. 8

UNIT – II

Surface Runoff: Components and factors affecting runoff, methods of estimation of runoff volume and peak runoff, rating curve, Rainfall – runoff relationships Hydrograph analysis: components, factors affecting hydrographs, base flow separation, Direct Runoff Hydrograph, Unit Hydrograph: Theory and assumptions. Derivation of Unit Hydrograph, Synthetic Unit Hydrograph Introduction to computer models for rainfall runoff analysis.

Irrigation: Developments in India, Necessity and types Advantages & disadvantages of irrigation. Functions of water in plant growth, Methods of Irrigation, Water requirement of crops. Irrigation frequency, Irrigation efficiencies, Principal crops and crop season, crop rotation.

Canal irrigation: Classes and alignment, Parts of a canal system, Commanded area, curves in channels, channel losses. 8

UNIT – III

Sediment Transportation: Suspended and Bed load and its estimation

Irrigation channels: Types: lined and unlined, silt theories: Kennedy's and Lacey's Design procedure for irrigation channels, Longitudinal cross section, Schedule of area

statistics and channel dimensions, use of Garret's Diagrams in channel design, cross sections of an Irrigation channel, Computer programs for design of channels

Lining of Irrigation Canals: Advantages and types, factors for selection of a particular type, design of lined channels, cross section of lined channels, Economics of canal lining. Water Logging: Definition, effects, causes and anti-water logging measures, Drainage of water logged land, Types of drains open and closed, spacing of closed drains. 8

UNIT – IV

Regulation and control of canal system: Purpose, Types of canal regulation works and their functional aspects

Irrigation Outlets: Requirements, types, non-modular, semi-module and rigid module, selection criterion

River Training: Objective and need, classification of rivers, and river training works, meandering, stages, methods of river training, bank protection, Methods for measurement of discharge. 8

UNIT – V

Ground Water Hydrology: Zones of underground water, Aquifers and their types, important terms, Determination of discharge through unconfined and confined aquifers with steady flow conditions, Interference among wells, determination of aquifer constants, Well loss and specific capacity, efficiency of a well, types of water wells, bored and open wells, specific yield of a well, Relative merits of well and canal irrigation, type of tube wells, well surrounding and well development, Suitable site selection for a tube well, Types of open wells, Methods of lifting water. Infiltration galleries.

Text Book

1. Irrigation Engg. and Hydraulic Structures by S.K. Garg, Khanna Publishers.
2. Irrigation and water Power engineering by B.C. Punmia, Laxmi Publications.
3. Engineering Hydrology by K. Subramanya, TMH.
4. Irrigation Water Power and Water Resource Engg. by K.R. Arrora.
5. Water resource engineering by Ralph A. Wurbs & Wesley P. James, Pearson Publication

References

1. Water Resources Engg. By Larry W. Mays, John Wiley India
2. Water resources Engg. By Wurbs and James, John wiley India
3. Water Resources Engg. By R. K. Linsley, McGraw Hill
4. Irrigation and water Resources Engg. By G L Asawa, New age International Publishers
5. Irrigation Theory and practices by A.M. Michel.
6. Fundamental of Hydraulic Engineering System by Houghalen, Pearson Publication.

ENVIRONMENT AND ECOLOGY (MC 301/ MC 401)

2 0 0 0

L T P C

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Describe a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.

CO2: Critically analyze technical subject matter (written or oral) for scientific merit apply learned environmental knowledge and understanding to solve technical /research problems in new contexts.

CO3: Effectively apply basic principles of the natural and social sciences to current issues of natural resources and the environment.

CO4: Understand and appropriately use the vocabularies of the natural and social sciences relevant to issues of natural resources and the environment.

UNIT-I: Nature of Environment Introduction to Environmental Science - Definition and scope and need for public awareness Ecosystems Concept, structure and functions, restoration of damaged ecosystems Biodiversity – Definition, description at national and global level, threats and conservation Natural Resources - Renewable and non-renewable and their equitable use for sustainability, Material cycles – carbon, nitrogen and sulphur cycle. Conventional and Non-conventional Energy Sources – fossil fuel-based, hydroelectric, wind, -nuclear and solar energy, biomass, biodiesel, hydrogen as an alternative fuel

UNIT-II: Impact of Human Activity on Environment Human Population and Environment – Population growth, population explosion and migration; Impact of farming, housing, mining,

transportation and industrial growth Social Issues Related to Environment– Sustainable development, urban problems (related to water and energy conservation and waste management), resettlement and rehabilitation Environmental ethics

UNIT-III: Environmental Changes and Human Health Environmental Pollution–Definition, causes and effects, control measures for water, air, soil, marine, land, noise, thermal pollution, Climate change– Greenhouse effect and global warming, acid rain, ozone layer formation and depletion Impact on human health – water and air borne diseases, diseases induced by residual impurities in drinking water (fluoride and arsenic); Toxic wastes and carcinogens; Nuclear hazards

UNIT- IV: Environmental Protection through Assessment and Education Indicators and Impact Assessment – Bio-indicators, Natural disasters and disaster management, Impact assessment through inventorying and monitoring Environmental Protection– Role of individuals, organizations and government in pollution control Laws, Conventions and Treaties–National legislation, issues in the enforcement of environmental legislation, initiatives by non- governmental organizations, global efforts in environmental protection Environmental education–women and value education Recommended

Textbook: Environmental Studies, J Krishnawamy , R J Ranjit Daniels, Wiley India. **Recommended Reference Books:**

1. Environmental Science, Bernard J. Nebel, Richard T. Right, 9780132854467, Prentice Hall Professional 1993.
2. Environment and Ecology, R K Khandal, 978-81-265-4277-2, Wiley India.
3. Environmental Science, 8th Ed ISV, Botkin and Keller, 9788126534142, Wiley India.
4. Environmental Studies, R Rajagopalan, 978-0195673937, Oxford University Press
5. Textbook of Environmental Science and Technology, M.Anjireddy, BS Publications
6. Environmental Studies, Soli. J Arceivala, Shyam, R Asolekar, 9781259006050, McGrawHill India, 2012.
7. Environmental Studies, D.L. Manjunath, 9788131709122 Pearson Education India, 2007
8. Textbook of Environment Ecology, Singh, Acme Learning
9. Perspective in Environmental Studies, Kaushik, New Age International
10. Environmental Studies, B. Joseph, 2nd Ed, 978-0070648134, Tata McGraw Hill

UNDERGRADUATE DEGREE COURSE

Bachelor of Engineering

IV Semester

Civil Engineering

Institute of Engineering & Technology, Khandari Campus

Dr. B R Ambedkar University, Agra

Effective from session: 2019-20

ENGINEERING FLUID MECHANICS - I (BCE 401)

L T P C 3 1 0 4

Course Outcome:

At the end of the course the student should be able to:

CO1: Understand property of fluid, measurement of pressure and broad principles of fluid statics.

CO2: Inculcate knowledge on description of fluid motion, stream and velocity potential, their properties and applications.

CO3: Understand the dynamics of fluid flow -energy equation and its applications and gain knowledge about dimensional and model analysis

CO4: Analyse the Flow through Pipes, Laminar and turbulent flows, major and minor losses in pipes.

CO5: Understand and solve the boundary layer problems and evaluate friction over surface.

UNIT-I

Introduction:

Scope and importance of Fluid Mechanics, Physical properties of fluids (density, specific weight, specific volume, sp. gravity, viscosity-Newton‘s law of viscosity, Newtonion and nonNewtonion fluids, Compressibility, Surface tension and Capillarity, Vapour Pressure), Rheological classification of fluids, Ideal fluid, Real fluid.

Fluid Statics:

Pressure, Pascal‘s Law, Hydrostatic Law, Pressure measurement devices – Piezometer, manometers, Mechanical gauges, Forces on plane and curved surfaces, Centre of pressure and pressure diagram, Buoyancy, Metacentre, Stability of Submerged and floating bodies, Fluid masses subjected to accelerations.

UNIT-II

Fluid Kinematics:

Concept of control volume, Velocity and acceleration of fluid Particle, Lagrangian and Eulerian approach, Classification of fluid flow (steady- unsteady, uniform-nonuniform, rotational – irrotational, turbulent–laminar, l-D,2-D, 3-D flow, compressible - incompressible flow), Streamlines, Path lines and Streak lines, Equipotential lines, Stream Function and Velocity Potential, Flow Net, Continuity equation, Rotation, Vorticity and Circulation, Free and Forced vortex motion.

UNIT-III

Fluid Dynamics:

Concept of control volume and control surface, Forces acting on fluid in motion, Euler‘s equation, Bernoulli's Theorem and applications – Pitot Tube, Venturimeter, Orificemeter, Orifices and Mouthpieces, Concept of HGL & TEL.

Dimensional Analysis: Units and Dimensions, Dimensional analysis, Rayleigh's method, Buckingham's Π theorem, Non-dimensional numbers & their significance.

Hydraulic Similitude and Model Studies: Model and prototype; Similitude; Geometric, Kinematic and Dynamic similarity; Model Laws; Un-distorted model studies.

UNIT-IV

Flow in pipes:
Laminar flow: Reynold's Experiment, Coutte& Hazen Poisulle's Equation for viscous flow between parallel plates and circular pipes, Stokes law; Flow through porous media; Darcy's Law; Fluidization; Measurement of viscosity; Transition from laminar to turbulent flow. Turbulant flow: Velocity distribution and Shear stresses in turbulent flow, Prandtl mixing length theory, Introduction to Moody's Chart.

Losses in pipes:
Darcy - Wiesbach Equation, factors affecting friction, Minor Losses in pipes, Concept of equivalent length of pipe for different pipe fittings, Equivalent diameter of pipes, Hydraulic Power, transmission by pipe, Pipes in parallel, Series, Syphon, two reservoir problems, Water hammer in pipes, Surge tanks - function, location and uses, Pipe network.

Unit-V
Boundary layer theory:
Concept, Boundary layer along thin plate- Characteristics, Laminar, Turbulent Boundary Layer, laminar sub layer, Various Thicknesses- Nominal, displacement, Momentum, Energy, Hydraulically smooth and Rough boundaries, Separation of Boundary layer, control of Separation.

Forces on submerged bodies: Introduction to Drag and Lift on submerged bodies (like Flat plates, Sphere, Cylinder, aerofoil), stokes law, Drag and Lift coefficients.

ENGINEERING FLUID MECHANICS LAB (BCE 451) L T P C- 0 0 2 1

List of Experiments: (At least 8 of the following)

1. To determine the metacentric height of a ship model experimentally.
2. To study the transition from laminar to turbulent flow and to determine the lower critical Reynolds number.
3. To determine the coefficients of velocity, contraction and discharge of an orifice (or a mouth piece) of a given shape.
4. To find the velocity distribution in a pipe and hence to compute the discharge by integrating the velocity profile obtained.

5. To verify the Bernoulli's theorem.
6. To determine coefficient of discharge of a nozzle.
7. To calibrate an orifice meter and venturimeter and to study the variation of the coefficient of discharge with the Reynolds number.
8. To verify Darcy's law and to find out the coefficient of permeability of the given medium.
9. To study the variation of friction factor, _f' for turbulent flow in smooth and rough commercial pipes.
10. To determine the loss coefficients for the various pipe fittings.
11. To study the flow visualization with help of water table set up

References:

1. Fluid Mechanics – A.K. Jain – Khanna Pub., Delhi
2. Fluid Mechanics – Hydraulic & Hydraulic Mechanics -Modi / Seth – Standard Book House, Delhi
3. Fluid Mechanics – Streeter-McGraw-Hill International Book Co., Auckland
4. Fluid Mechanics – Garde-Mirajgaonkar – Nemchand& Bros., Roorkee
5. Fluid Mechanics – Shames - McGraw-Hill International Book Co., Auckland 6. Som and Biswas: Introduction to
6. Fluid Mechanics and Machines, TMH.
7. R K Bansal: Fluid Mechanics and Hydraulic Machines.
8. Fluid Mechanics & Hydraulic Machines – Domkundwar & Domkundwar, Dhanpat Rai & Co.
9. Fluid Mechanics & Hydropower Engineering – D. S. Kumar, S.K. Kataria and Sons.
10. Fluid Mechanics and Machinery – Ojha, Berndtsson and Chandramouli, Oxford University Press

DISASTER MANAGEEMNT HSMC-401

L T P C 2 0 0 2

Course Outcomes (CO):

Upon successful completion of this course, students will be able to:

CO1. The student will develop competencies in the application of Disaster Concepts to Management

CO2. Analyzing Relationship between Development and Disasters.

CO3. Ability to understand Categories of Disasters, their impacts and realization of the responsibilities to society.

CO4. To gain understand approaches of Disaster Risk Reduction (DRR) and the relationship between vulnerability, disasters, disaster prevention and risk reduction

CO5. To provide basic conceptual understanding of disasters and its relationships with development.

Unit 1: Introduction - Concepts and definitions: disaster, hazard, vulnerability, risks severity, frequency and details, capacity, impact, prevention, mitigation).

Unit 2: Disasters - Disasters classification; natural disasters (floods, draught, cyclones, volcanoes, earthquakes, tsunami, landslides, coastal erosion, soil erosion, forest fires etc.); manmade disasters (industrial pollution, artificial flooding in urban areas, nuclear radiation, chemical spills, transportation accidents,

terrorist strikes, etc.); hazard and vulnerability profile of India, mountain and coastal areas, ecological fragility.

Unit 3: Disaster Impacts - Disaster impacts (environmental, physical, social, ecological, economic, political, etc.); health, psycho-social issues; demographic aspects (gender, age, special needs); hazard locations; global and national disaster trends; climate change and urban disasters.

Unit 4: Disaster Risk Reduction (DRR) - Disaster management cycle – its phases; prevention, mitigation, preparedness, relief and recovery; structural and non-structural measures; risk analysis, vulnerability and capacity assessment; early warning systems, Post disaster environmental response (water, sanitation, food safety, waste management, disease control, security, communications); Roles and responsibilities of government, community, local institutions, NGOs and other stakeholders; Policies and legislation for disaster risk reduction, DRR programmes in India and the activities of National Disaster Management Authority.

Unit 5: Disasters, Environment and Development - Factors affecting vulnerability such as impact of developmental projects and environmental modifications (including of dams, land use changes, urbanization etc.), sustainable and environmentally friendly recovery; reconstruction and development methods.

Text/Reference Books:

1. http://ndma.gov.in/ (Home page of National Disaster Management Authority)
2. http://www.ndmindia.nic.in/ (National Disaster management in India, Ministry of Home Affairs).
3. Pradeep Sahni, 2004, Disaster Risk Reduction in South Asia, Prentice Hall.
4. Singh B.K., 2008, Handbook of Disaster Management: Techniques & Guidelines, Rajat Publication.
5. Ghosh G.K., 2006, Disaster Management, APH Publishing Corporation
6. Disaster Medical Systems Guidelines. Emergency Medical Services Authority, State of California, EMSA no.214, June 2003
7. Inter Agency Standing Committee (IASC) (Feb. 2007). IASC Guidelines on Mental Health and Psychosocial Support in Emergency Settings. Geneva: IASC

STRUCTURAL ANALYSIS-I (BCE 402) **L T P C 3 1 0 4**

Course Outcomes:

Upon successful completion of this course, students will be able to:

CO1 Understand the concept of determinate and indeterminate structure.

CO2 Understand the effect of moving load and can analyze and draw the influence line diagrams.

CO3 Understand and apply different methods and theorems in the analysis of various structures**.**

CO4 Compute the effect of vertical loads on beams, columns and arches and understand the phenomenon related to it.

CO5 Understand the concept of degree of freedom and slope deflection and can apply the knowledge in analyzing the frames.

UNIT-I

Analysis of Beams: - Determination of reaction, shear force and bending moment for simply supported beam. lassification of Structures, stress resultants, degrees of freedom per node, Static and Kinematic determinacy. Classification of Pin jointed determinate trusses, Analysis of determinate plane and space trusses (compound and complex). Method of Substitution and Method of tension coefficient.

UNIT-II

Rolling loads, influence lines fur beams and trusses, Absolute maximum bending moment, Muller-Breslau's principal & its application for determinate structures.

UNIT-III

Analysis of Arches, Linear arch, Eddy's theorem, three hinged parabolic arch, spandrel braced arch, moving load & influence lines.

UNIT-IV

Strain Energy of deformable systems, Maxwell's reciprocal & Betti's theorem, Castigliano's first theorem, unit load & Conjugate beam methods.

UNIT-V

Unsymmetrical bending, location of neutral axis, computation of stresses and deflection, Shear Centre its location for common structural section. Bending of curved bars in plane of bending, stresses in bars of small &.large initial curvatures.

ESTIMATING & COSTING BCE-403

	L T P C
Course Outcome	**2 2 0 4**

Upon successful completion of this course, students will be able to:

CO1 Prepare the preliminary estimate for administrative approval & technical sanction for a civil engineering project.
CO2 Understand and write the specification of the works to be undertaken prepare the tender & contract documents and make use of knowledge of different contract submission & opening in awarding the work to the contractor.
CO3 Use & execute the concept of SD, EMD, MAS, Running Bill, Final Bill during the entire project
CO4 Prepare the bar bending schedule & also be able to find the quantity of steel
CO5 Use the technique of Rate analysis in estimating the exact cost of material & manpower and hence the entire project. & finding the rate per unit.
C06 Prepare the estimate the bill of quantities using different techniques of preliminary & detailed estimation of buildings & roads

Unit 1:*Estimation /* Measurements for various items- Introduction to the process of Estimation; Use of relevant Indian Standard Specifications for the same, taking out quantities from the given requirements of the work, comparison of different alternatives, Bar bending schedules, Mass haul Diagrams, Estimating Earthwork and Foundations, Estimating Concrete and Masonry, Finishes, Interiors, MEP works; BIM and quantity take-offs; adding equipment costs; labour costs; rate analysis; Material survey-Thumb rules for computation of materials requirement for different materials for buildings, percentage breakup of the cost, cost sensitive index, market survey of basic materials. Use of Computers in quantity surveying (7 lectures)

Unit 2: Specifications-Types, requirements and importance, detailed specifications for buildings, roads, minor bridges and industrial structures. (3 lectures)

Unit 3: Rate analysis-Purpose, importance and necessity of the same, factors affecting, task work, daily output from different equipment/ productivity. (3 lectures)

Unit 4: Tender- Preparation of tender documents, importance of inviting tenders, contract types, relative merits, prequalification. general and special conditions, termination of contracts, extra work and Changes, penalty and liquidated charges, Settlement of disputes, R.A. Bill & Final Bill, Payment of advance, insurance, claims, price variation, etc. Preparing Bids- Bid Price buildup: Material, Labour, Equipment costs, Risks, Direct & Indirect Overheads, Profits; Bid conditions, alternative specifications; Alternative Bids. Bid process management (6 lectures)

Unit 5: Introduction to Acts pertaining to-Minimum wages, Workman's compensation, Contracts, Arbitration, Easement rights. (1 lecture)

Term Work Assignments may include:
1. Deriving an approximate estimate for a multistoried building by approximate methods.
2. Detailed estimate for the following with the required material survey for the same.
a. Ground plus three storied RCC Framed structure building with blockwork walls
b. bridge with minimum 2 spans
c. factory building
d. road work
e. cross drainage work
f. Ground plus three storied building with load-bearing walls
g Cost of finishes, MEP works for (f) above
3. Preparation of valuation report in standard Government form.
4. Assignments on rate analysis, specifications and simple estimates.
5. Detailed estimate of minor structure.
6. Preparation of Bar bending schedule.

Text/Reference Books:

1. Mankiw Gregory N. (2002), *Principles of Economics,* Thompson Asia
2. V. Mote, S. Paul, G. Gupta(2004), *Managerial Economics,* Tata McGraw Hill
3. Misra, S.K. and Puri (2009), *Indian Economy,* Himalaya
4. Pareek Saroj (2003), *Textbook of Business Economics,* Sunrise Publishers
5. M Chakravarty, Estimating, Costing Specifications & Valuation
6. Joy P K, Handbook of Construction Management, Macmillan
7. B.S. Patil, Building & Engineering Contracts
8. Relevant Indian Standard Specifications.
9. World Bank Approved Contract Documents.
10. FIDIC Contract Conditions.
11. Acts Related to Minimum Wages, Workmen's Compensation, Contract, and Arbitration
12. Typical PWD Rate Analysis documents.
13. UBS Publishers & Distributors, Estimating and Costing in Civil Engineering: Theory and Practice including Specification and Valuations,2016
14. Dutta, B.N., Estimating and Costing in Civil Engineering (Theory & Practice), UBS Publishers, 2016

On completion of the course, the students will:

1. Have an idea of Economics in general, Economics of India particularly for public sector agencies and private sector businesses
2. Be able to perform and evaluate present worth, future worth and annual worth analyses on one of more economic alternatives.
3. Be able to carry out and evaluate benefit/cost, life cycle and breakeven analyses on one or more economic alternatives.
4. Be able to understand the technical specifications for various works to be performed for a project and how they impact the cost of a structure.
5. Be able to quantify the worth of a structure by evaluating quantities of constituents, derive their cost rates and build up the overall cost of the structure.
6. Be able to understand how competitive bidding works and how to submit a competitive bid proposal.

BCE 404 GEOTECH ENGINEERING

L T P C
3 0 0 3

Course Outcomes:

Upon successful completion of this course, students will be able to:

CO1: Understand the origin of the soil and geological cycle, phase diagram for soil properties and perform basic weight-volume calculations.Understand consistency of soil and soil classification.

CO2: Understand the basic science of soil compaction. Understand basics principles of flow and soil permeability through porous media including Bernoulli's equation, Darcy's Law, and Hydraulic conductivity. Understand seepage in soil include Laplace equation of continuity. Construct flow nets for water flow.

CO3: Understand how stresses are transferred through soils and be able to compute boussineq's and westergard equation and induced stresses due to point, line, and area loads. Estimate the amount of consolidation and settlement and time required for settlement under a given load.

CO4: Basic knowledge of shear strength principles including the Mohr-Coulomb failure criterion. understanding of Lateral Earth Pressure concept and theory including Rankine's and coloumb theory of active and passive earth pressures with and without sloping backfill.

CO5: Deep Knowledge of site investigation. Understand the basic concept of ultimate bearing capacity of shallow foundations including modification of bearing capacity equations for water table.

UNIT – 1

Origin and classification: Preview of Geotechnical field problems in Civil Engineering, Soil formation, transport and deposit, Soil composition, Basic definitions, Weight volume relationships, Clay minerals, Soil structure, Index properties, Particle size analysis, Soil classification.

UNIT – 2

Soil Hydraulics: Modes of occurrence of water in soil. Stress conditions in soil- total, effective and neutral stresses and relationships. Permeability - Bernaulli's equation, Darcy's Law, hydraulic conductivity, laboratory determination of hydraulic conductivity, equivalent hydraulic conductivity in stratified soil. Seepage- Laplace equation of continuity, flow nets, seepage calculation from a flow net, flow nets in anisotropic soils, seepage through earth dam, critical hydraulic gradient and quick sand condition. Soil

compaction, water content – dry unit weight relationships. Factors controlling compaction. Field compaction equipment; field compaction control; Proctor needle method.

UNIT – 3

Stresses in soils: Normal and shear Stresses on a plane, Stresses due to applied loads, Boussinesq's solution for a point load, line load, strip load, uniformly loaded circular and rectangular areas, Isobar and pressure bulb concept, stress distribution on horizontal and vertical planes, Newmark's chart and its application, contact pressure. Consolidation: Consolidation and compaction, primary and secondary consolidation, Terzaghi's one dimensional theory of consolidation, Consolidation test, Normal and Over Consolidated soils, Over Consolidation Ratio, determination of coefficient of consolidation, consolidation under construction loading.

UNIT – 4

Shear Strength: Mohr-Coulomb failure criterion, shear strength parameters and determination; direct and tri- axial shear test; unconfined compression test; vane shear test; sensitivity and thixotropy; pore pressure, Skempton' s pore pressure coefficients. Earth pressure: Classical theories, Coulomb and Rankine approaches for frictional and c-φ soils, Smooth and rough walls, Inclined backfill, graphical methods of earth pressure determination. Types of retaining structures.

UNIT – 5

Characterization of ground, site investigations, groundwater level, methods of drilling, sampling, in situ tests, SPT, CPT, DCPT.

Sub-Structures: Introduction to foundations- types and differences; choice; loads; design philosophies. Bearing capacity of shallow foundations; modes of failures; corrections for size, shape, depth and eccentricity; provisions of IS code of practice. Introduction to deep foundations.

Note: The students should be given a comprehensive problem at the end which requires inputs/ knowledge/ application from all the units of the syllabus. It may be evaluated as a part of TAQ•

Text & References Books

1. V.N.S. Murthy – Soil Mechanics and Foundation Engineering (Fifth Edition)
2. K.R. Arora – Soil Mechanics and Foundation Engineering
3. Narasinga Rao, B.N.D, "Soil Mechanics & Foundation Engineering", John Wiley & Sons, Wiley India Pvt. Ltd., Daryaganj, New Delhi – 110 002.
4. Alam Singh – Modern Geotechnical Engineering
5. Brij Mohan Das – Geotechnical Engineering , CENGAGE Learning
6. I.H. Khan – Text Book of Geotechnical Engineering
7. C. Venkataramaiah – Geotechnical Engineering
8. Gopal Ranjan and A.S.R. Rao – Basic and Applied Soil Mechanics
9. G.V. Rao & G.V.S.S. Raju – Engineering with Geosynthetics
10.P. Purushottam Raj- Soil Mechanics and

Foundation Engineering, Pearson Education in
South Asia, New Delhi.
11. Shenbaga R Kaniraj- Design Aids in Soil Mechanics and Foundation
Engineering 12.Gulati, S.K., "Geotechnical Engineering" McGraw Hill
Education
(India), Pvt. Ltd., Noida. Course Content

GEOTECH ENGINEERING LAB (BCE 454) L T P C - 0 0 2 1

Course Outcomes:

Upon successful completion of this course, students will be able to:

CO1: Identify and classify soil based on engineering properties of soil.

CO2: Understand and determine the density and shear strength parameters of soil of a soil using various tests.

CO3: Understand the use of different charts for classifying soil or knowing the stress under the soil.

1. Identification of gravel type, sand type, silt type and clay types soils; Tests for determination of Specific gravity (for coarse- and fine-grained soils) and Water content (Oven drying method).
2. Grain size analysis of soil sample (sieve analysis).
3. In situ density by core cutter and sand replacement methods.
4. Consistency Limits – Liquid Limit (Casagrande and Cone Penetration Methods), plastic limit and shrinkage limit.
5. Standard Proctor Compaction Test and Modified Proctor Compaction Test.
6. Coefficient of permeability by constant head and variable head methods.
7. Strength Tests
a. Unconfined Compression Test
b. Direct Shear Test
c. Triaxial Compression Test (undrained)
8. Consolidation Test- Determination of compression index and coefficient of consolidation.
9. Laboratory vane shear test
10. Determination of CBR value
11. a) Demonstration of miscellaneous equipments such as Augers, Samplers, Rapid Moisture meter, Proctor's needle.
b) Demonstration of Hydrometer Test.
c) Demonstration of Free Swell Index and Swell Pressure Test
d) Demonstration of determination of relative density of sands.
12. Preparing a consolidated report of index properties and strength properties of soil

Human Values and Professional Ethics (MC 401/MC 302)

Course Objective

L T P C
3 0 0 0

1. To help the students in distinguishing between values and skills, and understand the need, basic guidelines, content and process of value education.
2. To help the students initiate a process of dialog within themselves to know what they 'really want to be' in their life and profession
3. To help the students to understand the meaning of happiness and prosperity for a human being.
4. To facilitate the students to understand harmony at all the levels of human living, and live accordingly.
5. To facilitate the students in applying the understanding of harmony in existence in their profession and lead an ethical life

Course Outcome

On completion of this course, the students will be able to:

1. Understand the significance of value inputs in a classroom, distinguish between values and skills, understand the need, basic guidelines, content and process of value education, explore the meaning of happiness and prosperity and do a correct appraisal of the current scenario in the society
2. Distinguish between the Self and the Body, understand the meaning of Harmony in the Self the Co-existence of Self and Body.
3. Understand the value of harmonious relationship based on trust, respect and other naturally acceptable feelings in human-human relationships and explore their role in ensuring a harmonious society
4. Distinguish between ethical and unethical practices, and start working over the strategy to actualize a harmonious environment wherever they work.

UNIT-1

Course Introduction - Need, Basic Guidelines, Content and Process for Value ɔn

Understanding the need, basic guidelines, content and process for Value Education, Self-Exploration–what is it? - its content and process; 'Natural Acceptance' and Experiential Validation- as the mechanism for self-exploration, Continuous Happiness and Prosperity- A look at basic Human Aspirations, Right understanding, Relationship and Physical Facilities- the basic requirements for fulfilment of aspirations of every human being with their correct priority, Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario, Method to fulfill the above human aspirations.

UNIT-2 Understanding Harmony in the Human Being - Harmony in Myself Understanding human being as a co-existence of the sentient 'I' and the material 'Body', Understanding the needs of Self ('I') and 'Body' - Sukh and Suvidha, Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer), Understanding the characteristics and activities of 'I' and harmony in 'I', Understanding the harmony of I with the Body: Sanyam and Swasthya; correct appraisal of Physical needs, meaning of Prosperity in detail, Programs to ensure Sanyam and Swasthya.

UNIT-3

Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship Understanding harmony in the Family- the basic unit of human interaction, Understanding values in human-human relationship; meaning of Nyaya and program for its fulfillment to ensure Ubhay- tripti (Mutual Happiness); Trust (Vishwas) and Respect (Samman) as the foundational values of relationship, Understanding the meaning of Vishwas; Difference between intention and competence, Understanding the meaning of Samman, Difference between respect and disrespect; the other salient values in relationship, Understanding the harmony in the society (society being an extension of family): Samadhan, Samridhi, Abhay, Sah-astitva as comprehensive Human Goals, Visualizing a universal harmonious order in society.

UNIT-4 Understanding Harmony in the Nature and Existence - Whole existence as Co-existence Understanding the harmony in the Nature, Interconnectivity and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature, Understanding Existence as Co- existence (Sah-astitva) of mutually interacting units in all-pervasive space, Holistic perception of harmony at all levels of existence.

UNIT-5 Implications of the Holistic Understanding of Harmony on Professional Ethics Natural acceptance of human values, Definitiveness of Ethical Human Conduct, Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order, Competence in Professional Ethics: a) Ability to utilize the professional competence for augmenting universal human order, b) Ability to
identify the scope and characteristics of people-friendly and eco-friendly production systems, technologies and management models. Improving quality of work life at work place.

Text Books:

References:

1. R R Gaur, R Sangal, G P Bagaria, 2009, A Foundation Course in Human Values and Professional Ethics.
2. A Nagraj, 1998, Jeevan Vidya Ek Parichay, Divya Path Sansthan, Amarkantak
3. R. Subramanian,2017, Professional Ethics,
4. P L Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Publishers.
5. A N Tripathy, 2003, Human Values, New Age International Publishers.
6. SubhasPalekar, 2000, How to practice Natural Farming, Pracheen (Vaidik) KrishiTantraShodh, Amravati.
7. E G Seebauer & Robert L. Berry, 2000, Fundamentals of Ethics for Scientists & Engineers , Oxford University Press.

8. M Govindrajran, S Natrajan & V.S. Senthil Kumar, Engineering Ethics (including Human Values), Eastern Economy Edition, Prentice Hall of India Ltd.
9. B P Banerjee, 2005, Foundations of Ethics and Management, Excel Books.
10. B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008.

Syllabus of

UNDERGRADUATE DEGREE COURSE

Bachelor of Engineering

V Semester

Civil Engineering

Institute of Engineering & Technology, Khandari Campus

Dr. B R Ambedkar University, Agra

Effective from session: 2020-21

PCC	**ENVIRONMENTAL ENGINEERING**	**BCE 501**	**3 1 0**	**4 CREDITS**

COURSE OUTCOMES:	
CO1	Analyze characteristics of water and wastewater
CO2	Estimate the quantity of drinking water and domestic wastewater generated
CO3	Design components of water supply systems
CO4	Design sewerage system.
CO5	Design of waste water filtration plants.

Unit-1

Fresh water, water demands, variation in demands, population forecasting by various methods, basic needs and factors affecting consumption, design period.

Transmission of water: Various types of conduits, capacity and sizes including economical sizes of rising main, structural requirements; laying and testing of water supply pipelines; pipe materials, joints, appurtenances and valves; leakages and control.

Unit-2

Storage and distribution of water: Methods of distribution, pressure and gravity distribution systems, Concept of service and balancing reservoirs.

Capacity of distribution reservoirs: general design guidelines for distribution system.

Unit-3

Physical, chemical and bacteriological examination of water and wastewater: Temperature, pH, colour and odour, solids, nitrogen and phosphorus, chlorides, toxic metals and compounds, BOD, COD etc. quality requirements, standards of water and waste water, disposal of wastewater on land and water bodies.

Unit-4

Objectives of water treatment: unit operations, processes, and flow sheets.

Water treatment: screening, sedimentation, determination of settling velocity, efficiency of ideal sedimentation tank, design of settling tanks, grit chamber.

Primary sedimentation and coagulation, filtration: theory of filtration; hydraulics of filtration; slow sand, rapid sand and pressure filters, backwashing; design of slow and rapid sand filters.

Disinfection: requirements of an ideal disinfectant; various disinfectants, chlorination and

practices of chlorination, water softening and ion-exchange process

Unit-5

Objectives of waste water treatment: unit operations, processes, and flow sheets.

Secondary and tertiary treatment: secondary sedimentation and theory of organic matter removal. Working of activated sludge process, trickling filters; aerated lagoons, waste stabilization ponds, oxidation ditches, rotating biological contactors (RBC).

Anaerobic digestion of sludge: design of low and high rate anaerobic digesters and septic tank. Working of up flow anaerobic sludge blanket (UASB) reactor and other emerging technologies for wastewater treatment.

Text Books:

1. Peavy, Howard S., Rowe, Donald R and Tchobanoglous, George, "Environmental Engineering" McGraw Hill Education (India) Pvt. Ltd., New Delhi.
2. Metcalf & Eddy "Wastewater Engineering: Treatment & Reuse", Tata Mc-Graw Hill.
3. M. P. Poonia and SC Sharma: Environmental Engineering, kahnna publishing house
4. Keshav Kant, "Air Pollution Control Engineering", Khanna Publishing House
5. OP Gupta, Elements of Environmental Polluton Control, Khanna Publication
6. Davis, M.L. & Cornwell, D.A.: Introduction to Environmental Engineering, Mc-Graw Hill.

References:

1. Manual on Water Supply and Treatment, C. P. H. E. E. O., Ministry of Urban Development, Government of India, New Delhi
2. Manual on Sewerage and Sewage Treatment, C. P. H. E. E. O., Ministry of Urban Development, Government of India, New Delhi
3. Steel and McGhee: Water Supply and Sewerage
4. Fair and Geyer: Water Supply and Wastewater Disposal
5. Hammer and Hammer Jr.: Water and Wastewater Technology
6. Raju: Water Supply and Wastewater Engineering
7. Rao: Textbook of Environmental Engineering
8. Davis and Cornwell: Introduction to Environmental Engineering
9. Kshirsagar: Water Supply and Treatment and Sewage Treatment Vol. I and II
10. Punmia: Water Supply and Wastewater Engineering Vol. I and II

LC	ENVIRONMENTAL ENGINEERING Lab	BCE 551	0 0 2	1 CREDIT
COURSE OUTCOMES:				
CO1	Determine physical, chemical and biological characteristics of water and wastewater			
CO2	Determine optimum dosage of coagulant			
CO3	Determine break - point chlorination			
CO4	Assess the quality of water and wastewater			

1. Determination of pH.

2. Determination of Conductivity.

3. Determination of Acidity of water.

4. Determination of Alkalinity of Water.

5. Determination of Chlorides.

6. Determination of Hardness of water.

7. Determination of Fluorides.

8. Determination of Available Chlorine in bleaching powder.

9. Conducting Break Point Chlorination Test.

10. Determination of Residual Chlorine.

11. Determination of Dissolved Oxygen.

12. Determination of Chemical Oxygen Demand.

13. Determination of Biochemical Oxygen Demand.

14. Conducting Jar test for determining optimum dosage of coagulant.

15. Determination of Total Solids, Total Dissolved Solids & Settelable Solids.

PCC	ENGINEERING GEOLOGY	BCE 502	3 0 0	3 CREDITS
COURSE OUTCOMES:				
CO1	Students are able to identify the different rocks and minerals based on their property			
CO2	Students are able to understand the different method of geological exploration			
CO3	Understand the earthquake causes.			
CO4	Understand the underground water Sources.			
CO5	Students are able to understand the different geological structures and their impact on civil engineering structure.			

Unit I

Earth Sciences and its importance in Civil Engg. Minerals and their physical properties. Study of common rock forming minerals. Internal structure of the earth. Suitability of rocks as engineering materials. Building stones occurrences and characteristics, Selection, Rocks origin, Characteristics, Texture, Structure and classification of igneous, sedimentary and metamorphic rocks. Engineering properties of rocks.

Unit-II

Strike and dip of Strata, Folds, Faults, Joints, Unconformity and their Classification, Causes and relation to engineering behavior of rock masses. Overlap. Landslides- causes, classification and preventive measures.

Unit-III

Earthquake causes, Classification, Earthquake waves, Intensity and magnitude, Seismic zones for India, Geological consideration for construction of building.

Unit IV

Underground water, Sources, Aquifer, Aquiclude, Artesian well, Ground water provinces of India and its role as geological hazard.

Unit-V

Geological investigations for site selection of dams & reservoirs, Tunnels, Bridges and highways. Reservoir induced seismicity. Methods of Geophysical explorations-gravity, electrical and seismic methods.

Course outcomes:

As a student in the Bachelor of Engineering will undertake courses in geology Such as Rock and mineral.

References:

- Singh, Parbin., _General and Engineering Geology‖Katson Publishing House, Delhi.
- Mukharjee, P.K.., –A Text Book of Geology|, Calcutta Word Publishers.
- Leggot, R.F.., –Geology and Engineering|, Mc Graw Hill, New York.

LC	ENGINEERING GEOLOGY LAB	BCE 552	0 0 2	1 CREDITS
COURSE OUTCOMES:				
CO1	Identify minerals and rocks			
CO2	Measure strike and dip of the bedding planes			

List of Experiments

1. Study of Physical properties of minerals
2. Identification of rocks forming silicate and ore minerals
3. Recognition of rocks
4. Use of clinometers compass and Burton compass for measurement dip and strike of formations.
5. Geological cross sections and study of geological maps.
6. Study of models of geological structures and out crops patterns of different types of rocks and land forms

PCC	STRUCTURAL ANALYSIS-II	BCE 503	3 1 0	4 CREDITS
COURSE OUTCOMES:				
CO1	Demonstrate the concepts of qualitative influence line diagram for continuous beams and frames.			
CO2	Analyze of Continuous beam & Frame by Moment-Distribution Method.			
CO3	Analyze of Vertical & Horizontal loads by Approximate Method.			
CO4	Identify Plastic analysis of beams & frames.			
CO5	Apply the methods of indeterminate truss analysis.			

Unit-I

Slope-Deflection Method: Slope deflection equation, analysis of continuous beams and rigid frames

Unit II

Moment-Distribution Method: Analysis of continuous beams and rigid frames Kani's Method: Basic concepts, analysis of continuous beams and rigid frames

Unit-III

Approximate Method: Approximate analysis for vertical loads and horizontal loads as applied to multi-storeyed frames

Unit IV

Plastic analysis of Structures: Basics of plastic analysis, application of static & kinematic theorem for plastic analysis of beams and frames. Analysis of beams curved in plan.

Unit V

Basics of force and displacement matrix methods for beams, frames and trusses.

LC	STRUCTURAL ANALYSIS-II LAB	BCE 553	0 0 2	1 CREDITS
COURSE OUTCOMES:				
CO1	Verification of reciprocal theorem and moment area theorem			
CO2	Analysis of truss and curved members			
CO3	Analysis of three hinge arches			
CO4	Determine elastic properties of beam and analysis of struts			

List of Experiments

1. To determine the flexural rigidity (EI) of a given beam.
2. To verify Maxwell's reciprocal theorem.
3. To find horizontal thrust in a three hinged arch and to draw influence line diagram for horizontal thrust and bending moment.
4. To find horizontal thrust in a three hinged arch and to draw influence line diagram for horizontal thrust and bending moment.
5. To find deflection of curved members.
6. To find deflection in a fixed beam.
7. To find shear force and bending moment of a simply supported beam.
8. To find critical load in struts with different end conditions.
9. To find forces in elastically coupled beams.
10. To find deflection in beam having unsymmetrical bending.
11. To analyze the portal frame for deflection and horizontal reaction.
12. To verify the cable tension in suspension bridge.

References :

- Wilbur and Norris, –Elementary structural analysis‖, Tata McGraw Hill.
- Reddy, C.S., –Basic structural analysis‖, Tata McGraw Hill.
- Jain, O.P. and Jain, B.K., –Theory & analysis of structures‖, Vol. I & II, Nem Chand & Bros.
- Gupta,S.P.& G.S. Pandit., –Theory of structures‖. Tata McGraw Hill Publication
- Coates, R.C., Coutie, M.G. & Kong, F.K., –Structural analysis‖, ELBS
- Ghali, A. & Neville, M., ―Structural analysis‖, Chapman & Hall Publications
- Jain, A.K. –Advanced structural analysis‖, Nem Chand & Bros, Roorkee.
- Jain, O.P. & Arya A.S., –Theory of structures‖, Vol. II, Nem Chand Bros
- Kinney, J.S., –Intermediate structural analysis‖, McGraw Hill Book Company
- Nautiyal, B.D., –Intermediate structural Analysis‖, New Age International
- Chu – kia Wang, –Statically indeterminate structures‖, McGraw Hill
- Thandavamoorthy, T.S., ― Structural analysis‖, Oxford University Press
- Hibbeler, R.C., ― Structural analysis‖, Pearson Education
- Sinha, N.C., ― Elements of structural analysis‖, NCBA Ltd.
- Timoshenko, S.P. and D. Young,‖ Theory of structures‖, McGraw Hill
- Dayaratnam, P.,‖Analysis of statically indeterminate structures‖, Affiliated East-West press.
- Weaver and Gere, –Matrix analysis of framed structures‖

MC	OCCUPATIONAL HEALTH AND SAFETY	MC 501	2 0 0	0 CREDIT
COURSE OUTCOMES:				
CO1	Understand the diseases associated with occupation.			
CO2	Manage safety in industries by suggesting safety measures.			
CO3	Identify the accidental causes & apply the preventions.			
CO4	Identify Fire Explosion & apply PPE.			
CO5	Identify & apply Hazards & Risk identification, Assessment and control techniques.			

Unit I

Occupational Health:

Classification of occupational health hazards, dangerous properties of chemical and their health effects, routes of entry of toxic material into human body, permissible exposure limits, Threshold limit value, lethal dose and lethal concentration, Ergonomics, constituents of ergonomics, application of ergonomics for safety & health, occupational diseases due to metals & dusts, fumes & chemical compounds.

Unit II Safety

Concept, Philosophy & Psychology of safety: Concept of safety, Nature of concept of safety, Philosophy of safety, safety terminology, philosophy of total safety concept, safety psychology, accident causative factors, general psychological factors

Unit III

Accident Causes and prevention:

Causation, Accident problem, Reasons for prevention, factors impending safety, Accident prevention

Safety Management:

Concept of management, element of management, functions, management principles, safety management & its responsibilities, safety Organization

Electrical Safety:

Electricity and Hazardous, Indian standards, effects of electrical parameters on human body, safety measures for electric works

Unit IV

Fire and Explosion: Fire phenomena, classification of fire and extinguishers, statutory and other standards, fire prevention & protection system, explosion phenomena, explosion control devices, fire awareness signs

Personal Protective Equipment: Need of PPE, Indian standards, factors of selection of PPE, non respiratory equipments, respiratory equipments.

Unit V

Hazards & Risk identification, Assessment and control techniques: Hazards, Risks & detection techniques, Preliminary hazard analysis(PHA) & hazard analysis(HAZAN), failure mode effect analysis(FMEA), Hazard and operability(HAZOP) study, Hazard ranking (DOW & MOND index), Fault tree analysis, Event tree analysis(ETA), major accident hazard control, on-site and off-site emergency plans. Safety in different industries as case study

Syllabus of

UNDERGRADUATE DEGREE COURSE

Bachelor of Engineering

VI Semester

Civil Engineering

Institute of Engineering & Technology, Khandari Campus

Dr. B R Ambedkar University, Agra

Effective from session: 2020-21

HSMC	**ECONOMICS FOR INDUSTRY**	**HSMC 601**	**2 0 0**	**2 CREDITS**

COURSE OUTCOMES:				
CO1	Define the main concepts and describe the models and methods in economic analysis			
CO2	Explain economic events in individual markets and the aggregate economy using basic theory and tools			
CO3	Apply supply and demand analysis to relevant economic issues			
CO4	Explain how individual decisions and actions as a member of society affect the economy locally, nationally and internationally			
CO5	Distinguish between perfect competition and imperfect competition and explain the welfare loss in non-competitive markets			

Unit 1

Introduction of Engineering Economics and Demand Analysis: Meaning and nature of Economics, Relation between science, engineering, technology and economics; Meaning of Demand, Determinants of Demand, Shifts in demand, Law of Demand, Price Elasticity of Demand &Types, Income Elasticity, Cross price Elasticity, Determinants of Elasticity, uses and importance of elasticity.

Unit 2

Concept of Supply: Law of Supply, Factors affecting Supply, Elasticity of supply.

Demand Forecasting: Introduction, Meaning and Forecasting, Methods or Techniques of Demand Forecasting, Criteria for Good Demand Forecasting, Demand Forecasting for a New Product;

Unit 3

Cost Analysis- Introduction, Types of Costs, Cost-Output Relationship: Cost Function, Cost-Output Relationships in the Short Run, and Cost-Output Relationships in the Long Run; Short run and long run, Break- Even Analysis; Production functions: laws of variable proportions, law of returns; Economies of scale: Internal and external.

Unit 4

Market Structure: Market Structure Perfect Competition, Imperfect competition – Monopolistic, Oligopoly, duopoly sorbent features of price determination and various market conditions.

Unit 5

Nature and characteristics of Indian economy, concepts of LPG, elementary concepts of National Income, Inflation and Business Cycles ,Concept of N.I. and Measurement., Meaning of Inflation, Types and causes , Phases of business cycle .Investment decisions for boosting economy(National

income and per capital income)

PCC	HYDRAULIC AND HYDRAULIC MACHINES	BCE 601	3 1 0	4 CREDITS
COURSE OUTCOMES:				
CO1	Understanding the Computation of drag and lift coefficients			
CO2	Analyzing channels for design			
CO3	Understanding flow profiles in channel transitions and analyze hydraulic transients			
CO4	Evaluating the working proportions of hydraulic machines			
CO5	Analyzing compressible flows of liquids and gases			

Unit-I

Introduction: Difference between pipe flow and open channel flow. Types of open channels, Types of flows in open channel, Geometric elements, Velocity distribution, Velocity and pressure distribution in an open channel, Continuity equation. Uniform Flow: Chezy's& Manning's formula, Roughosity coefficient, Uniform Flow computations, Hydraulically efficient section (Rectangular, Triangular, Trapezoidal), compound channel sections.

Unit-II

Depth energy relationship in open channel flow:Specific energy (definition & diagram, Critical, Sub-critical, Super-critical flow), Specific force, Specific discharge, flow through vertical and horizontal contractions.

Unit-III

Gradually varied flow (G.V.F.):Definition, Classification of channel Slopes, Dynamic equation of G.V.F.(Assumption and derivation), Classification of G.V.F. profiles-examples, Direct step method of Computation of G.V.F. profiles.

Unit-IV

Rapidly varied flow (R.V.F.):Definition, examples, Hydraulic jump- Phenomenon, relation of conjugate depths, Parameters, Uses, Types of Hydraulic jump, Hydraulic jump as an energy dissipater, Notches & Weirs : Types, derivation of discharge equation, Sharp, broad & round crested weirs.

Unit-V

Impact of jet: Impulse momentum principle, Impact of jet on Vanes-flat, curved (stationary and moving), Inlet & outlet velocity triangles, Series of flat, curved vanes mounted on wheel.

Hydraulic turbines: Importance of hydro-power, Classification of turbines, description, Typical dimensions and working principle of Pelton, Francis & Kaplan turbine, Unit quantities, Specific speed, Performance Characteristics, Selection of type of turbine, description & function of Draft tube

LC	HYDRAULIC & HYDRAULIC MACHINES LAB	BCE 651	0 0 2	1 CREDIT
COURSE OUTCOMES:				
CO1	Determine Manning's and Chezy's coefficients for smooth and rough channels			
CO2	Understand the velocity distribution in an open channel flow.			
CO3	Understand the various characteristics of pump.			
CO4	Determine the coefficient of discharge for notches.			
CO5	Interpret the lab results keeping in mind the real life scenarios			

List of Experiments

1. To determine the Manning's coefficient of roughness _n' for the given channel bed.
2. To study the velocity distribution in an open channel and to find the energy and momentum correction factors.
3. To study the flow characteristics over a hump placed in an open channel.
4. To study the flow through a horizontal contraction in a rectangular channel.
5. To calibrate a broad-crested weir and sharp crested spillway.
6. To study the characteristics of free hydraulic jump.
7. To study the flow over an abrupt drop and to determine the end (brink) depth for a free over fall in an open channel.
8. To study rotodynamic pumps and their characteristics.
9. To study rotodynamic turbines and their characteristics.
10. To calibrate and to determine the coefficient of discharge for rectangular and triangular notches.
11. To verify the momentum equation.

References:

1. Subramanya, K., Flow in Open Channels, Tata McGraw Hill
2. Srivastava R., Flow through open channel, Oxford university press.
2. Henderson, F.M., Open Channel Flow, McGraw Hill International
3. Chow, V.T., Open channel Hydraulics, McGraw Hill International
4. Ranga Raju, K.G., Flow through open channels, T.M.H.
5. French, R.H., Open Channel Hydraulics, McGraw Hill International
6. Graf, W.H., Hydraulics of Sediment Transport, McGraw Hill International
7. Fluid Mechanics – K. Subramanyam – Tata McGraw-Hill Pub. Co., Delhi
8. Fluid Mechanics – Hydraulic & Hydraulic Mechanics -Modi / seth – Standard Book House Delhi

PCC	TRANSPORTATION ENGINEERING	BCE 602	3 1 0	4 CREDITS
COURSE OUTCOMES:				
CO1	Know about the historical development of roads and road development plans of India			
CO2	Design the components of Highway geometry according to the IRC.			
CO3	Learn about traffic characteristics, traffic studies, traffic control devices including the design of traffic signals and rotary intersections.			
CO4	Design the flexible pavement and rigid pavement according to the IRC: 37-2001 and IRC: 58-2011 respectively. Describe the highway materials used for road construction and their tests.			
CO5	Describe the highway construction methods generally used in India and the type of failures in pavement. Evaluate and design the overlay using Benkelman beam's method.			

UNIT-1

Introduction: Role of Transportation, Modes of Transportation History of road development, Road types and pattern, Nagpur road plan, Bombay road plan & 3rd 20 Year Road Plan, Highway Alignment & Location Survey: Horizontal Profile, Vertical Profile, Factors Controlling the alignment, Survey for route location,

UNIT-2

Geometric Design(IRC:73-Latest revision): Cross sectional elements, camber, shoulder, sight distance, horizontal curves, super elevation, extra widening, transition curves and gradient, vertical curves, summit and valley curves.

UNIT-3

Traffic Engineering: Traffic Characteristics, Traffic studies on flow, speed, travel time - delay and O-D study, PCU, peak hour factor, parking study, accident study and analysis, traffic capacity, density, traffic control devices: signs, Island, signal design by Webster's and IRC method . Intersection at grade and grade separated intersections, design of roundabouts as per IRC: 65-2017. Highway capacity and level of service of rural highways and urban roads as per latest IRC recommendation

UNIT-4

Highway Materials: Properties of Subgrade, Aggregates & Binding materials, Various tests and specifications, Design of Highway Pavement : Types of Pavements, Design factors, Design of bituminous paving mixes; Design of Flexible Pavement by CBR method (IRC : 37- Latest revision), Design of rigid pavement, Westergaard theory, load and temperature stresses, joints, IRC method of rigid pavement design (IRC:58-2015)

UNIT-5

Highway Construction: Construction of Subgrade, Water Bound Macadam (WBM), Wet mix macadam (WMM), Granular Sub Base (GSB),Tack Coat, Prime Coat, Seal Coat, Surface Dressing, Bituminous Macadam (BM), Semi dense bituminous concrete (SDBC) and Bituminous concrete, Dry lean concrete (DLC), Cement Concrete (CC) road construction, Roller Compacted Concrete Roads.

Text Book:

1. Khanna S. K., Justo C.E.G, & Veeraragavan, A. "Highway Engineering", Nem Chand and Bros., Roorkee- 247 667.
2. Khanna S. K., Justo C.E.G, & Veeraragavan A., "Highway Materials and Pavement Testing", Nem Chand and Bros., Roorkee- 247 667.
3. LR Kadiyali, Transportation Engineering, Khanna Publication.

References:

1. L.R. Kadiyali, Transportation Engineering, Khanna Publishing House
2. Saxena, Subhash C, A Textbook of Highway and Traffic Engineering, CBS Publishers & Distributers, New Delhi
3. Kumar, R Srinivasa, "A Text book of Highway Engineering", Universities Press, Hyderabad.
4. Kumar, R Srinivasa, "Pavement Design", Universities Press, Hyderabad.
5. Chakraborty Partha & Das Animesh., "Principles of Transportation Engineering", Prentice Hall (India), New Delhi,

LC	TRANSPORTATION ENGINEERING LAB	BCE 652	0 0 2	1 CREDIT
COURSE OUTCOMES:				
CO1	Understand the significance of laboratory tests performed on highway materials			
CO2	Study about the desired properties of highway materials			
CO3	Study and perform various lab tests procedures and safety precautions to be taken care of while performing tests.			
CO4	Interpret the lab results keeping in mind the real life scenarios			

Note: A minimum of 8 experiments are to be performed from the list of Experiments.

1. To Determine the Crushing Value of Coarse Aggregates.
2. To Determine the Impact Value of Coarse Aggregates.
3. To determine the Flakiness Index and Elongation Index of Coarse Aggregates.
4. To determine the Los Angeles Abrasion Value of Coarse Aggregates.
5. To determine the Stripping Value of Coarse Aggregates.
6. To determine the penetration Value of Bitumen.
7. To determine the Softening Point of Bituminous material.
8. To determine the Ductility Value of Bituminous material.
9. To determine the Flash and Fire Point of Bituminous material.
10. To determine the Stripping Value of Bituminous material.
11. Classified both directional Traffic Volume Study.
12. Traffic Speed Study. (Using Radar Speedometer or Endoscope).
13. Determination of CBR Value of soil sample in the Lab or in Field.

LC	CAD LAB	BCE 653	0 0 6	3 CREDIT
COURSE OUTCOMES:				
CO1	Identify the available open source software tools used for specific problems in Civil Engineering.			
CO2	Use the latest software tools for Modeling, Analysis and Design of Civil Engineering Systems.			

1. Working on Latest Version of ANALYSIS SOFTWARE LIKE ANSYS , ADINA , NISA, MATLAB
2. Working on Latest Version of DESIGN SOFTWARE LIKE STAAD PRO / STRUDS / SAP / ETAB / STRAP
3. Working on Latest Version of Environmental Engineering software for Analysis and Design of water & wastewater treatment and distribution systems (WATER CAD / SEWER CAD / WATER GEM / SEWER GEM /LOOP)
4. Working on Latest Version of Transportation Engineering software like MAX ROAD/ Surveying Software.

Syllabus of

UNDERGRADUATE DEGREE COURSE

Bachelor of Engineering

VII Semester

Civil Engineering

Institute of Engineering & Technology, Khandari Campus

Dr. B R Ambedkar University, Agra

Effective from session: 2021-22

PCC	CONSTRUCTION PLANNING & MANAGEMENT	BCE 701	3 0 0	3 CREDITS

COURSE OUTCOMES:	
CO1	Understand the modern management techniques like as CPM/PERT with network analysis.
CO2	Identify the equipment used in construction
CO3	Prepare tender and contract document for a construction project
CO4	Understand & specify the public work accounts.
CO5	Prepare schedule of activities in a construction project

Unit -I

Preliminary and detailed investigation methods: Methods of construction form work and centering. Schedule of construction, job layout, principles of construction management, modern management techniques like CPM/PERT with network analysis.

Unit -II

Construction equipments: Factors affecting selection, investment and operating cost, output of various equipments, brief study of equipments required for various jobs such as earth work, dredging, conveyance, concreting, hoisting, pile driving, compaction and grouting.

Unit -III

Contracts: Different types of controls, notice inviting tenders, contract document, departmental method of construction, rate list, security deposit and earnest money, conditions of contract, arbitration, administrative approval, technical sanction.

Unit -IV

Specifications & Public Works Accounts: Importance, types of specifications, specifications for various trades of engineering works. Various forms used in construction works, measurement book, cash book, materials at site account, imprest account, tools and plants, various types of running bills, secured advance, final bill.

Unit-V

Site Organization & Systems Approach to Planning: Accommodation of site staff, contractor's staff, various organization charts and manuals, personnel in construction, welfare facilities, labour laws and human relations, safety engineering. Problem of equipment management, assignment model, transportation model and waiting line modals with their applications, shovel truck performance with waiting line method.

Reference Books:-

1. Construction Equipment by Peurify
2. CPM by L.S. Srinath
3. Construction Management by S. Seetharaman
4. CPM & PERT by Weist & Levy

5. Construction, Management & Accounts by Harpal Singh

6. Tendering & Contracts by T.A. Talpasai

PCC	DESIGN OF CONCRETE STRUCTURE	BCE 702	3 1 0	4 CREDITS
COURSE OUTCOMES:				
CO1	Understand various concrete making materials, apprehend design philosophies used in design and analysis of reinforced concrete structures and use Working Stress Method (WSM) in the design and analysis of RCC beams in bending.			
CO2	Apply Limit State Method (LSM) in the design and analysis of RCC beams in bending.			
CO3	Examine the behavior of RCC beams in shear and torsion and their design using LSM.			
CO4	Identify one-way and two-way slab and Use LSM in Design of one-way and two-way slab in shear, bending and torsion.			
CO5	Understand various assumptions used in design of columns, evaluate effective length and slenderness ratio of column and analyze and design a short column under axial load, and uni-axial and bi-axial bending.			

Unit - 1

Introduction: Objective, scope and outcome of the course.
Fundamental concepts of design of RC members, assumptions. Types and function of reinforcement. Introduction to various related IS codes, Characteristic load and characteristic strength.
Working Stress Method: Working stress design philosophy. Analysis and Design of singly reinforced rectangular beam section for flexure.

Unit 2

Limit State Design: Limit state design philosophy. Assumptions, Analysis and design of singly reinforced, doubly reinforced rectangular beams and flanged beams for flexure using codal provisions for simply supported, cantilever, fixed and continuous beams.

Unit 3

Limit state of serviceability for deflection: control of deflection as per codal provisions of empirical coefficients.

Limit state of collapse in shear: Types of shear reinforcement and its detailing, analysis and design of shear reinforcement for prismatic sections.

Limit state of collapse in bond: concept of bond stress, anchorage length and development length. Detailing and curtailment of reinforcement as per codal provisions.

Unit 4

Slabs: Analysis and design of one way and two way slabs using LSM, Detailing of reinforcement. Check for shear and deflection.

Torsion: Analysis and Design of beams for torsion as per codal method.

Unit 5

Columns: Short and long columns, their structural behaviour. Analysis and design of axially loaded short columns, using LSM. Analysis of eccentrically loaded short columns. Introduction to Pu- Mu interaction curves and their use for eccentrically loaded columns. **Footings:** Analysis and design of Isolated column footing for axial load. Introduction to combined footing for two columns (without central beam) for axial loads using LSM.

Reference Books/ Text Book / Cases:

- Dayaratnam P. Limit State Design of Reinforced Concrete Structures New Delhi: Oxford Publishers; 2008.
- GambhirM.L Fundamentals of Reinforced Concrete Design New Delhi: PHI Publisher; 2009.
- IS: 456:2000 Plain and Reinforced Concrete - Code of Practice New Delhi: Bureau of Indian Standards.
- Krishna Jai Plain and Reinforced Concrete Vol.1 Roorkee: Nem Chand Brothers;2007.
- Jain A.K. Reinforced Concrete: Limit State Design Roorkee: Nem Chand and Brothers; 2007.
- Krishna Raju N. Pre stressed Concrete New Delhi: Tata Mc Graw Hill; 2007.
- Menon D .and Pillai, S. Reinforced Concrete DesignNew Delhi: Tata Mc Graw Hill; 2007.

Syllabus of
UNDERGRADUATE DEGREE COURSE

Bachelor of Engineering

VIII Semester

Civil Engineering

Institute of Engineering & Technology, Khandari Campus

Dr. B R Ambedkar University, Agra

Effective from session: 2021-22

PCC	DESIGN OF STEEL STRUCTURE	BCE 801	3 0 0	3 CREDITS
COURSE OUTCOMES:				
CO1	Understand the advantages and disadvantages of steel as a structural material.			
CO2	Create simple bolted and welded connections.			
CO3	Analyze and design Tension members, Compression members, Flexural members.			
CO4	Analyze & Design of Beams & Columns.			
CO5	Analyze & Design of Girder.			

Unit I

Introduction: Objective, scope and outcome of the course.

Types of Steels and their broad specifications.
Structural steel forms- hot rolled, tubular, light gauge etc and their applicability.
Classification of cross sections as per IS 800-2007- Plastic, compact, semi compact and slender- characteristics

Unit II

Plastic analysis of steel structures, fundamentals, shape factor, static and mechanism method of analysis, bending of beams of uniform cross sections (any shape)

Connections: Types of bolts, load transfer mechanism, prying action.
Design of bolted and welded connections under axial and eccentric loadings with IS Provisions

Unit III

Tension Members: Design strength in gross section yielding, net section rupture and block shear. Design of axially loaded members.

Compression Members: Types of buckling, Imperfection factor, Buckling curves for different cross sections as per IS. Design of compression members: Axially loaded members including made up of angle section: single and in pair; built up columns including design of lacings and battens as per IS.

Unit IV

Beams: Design of beams: simple and compound sections. Design of laterally supported and unsupported beams including for web buckling, web crippling, lateral torsional buckling.

Member design under combined forces: Compressive load and uniaxial

moment. tension and uniaxial moment

Column Bases: Design of column bases for axial and eccentric

Compressive loads: Slab and gusseted base.

Unit V

Design of plate girder: Design of welded and bolted sections including web and flange splicing, horizontal, intermediate and bearing stiffeners. Shear strength determination by post critical and tension field action methods. End panel design options and procedure as per IS 800. Curtailment of flange plates. Connections for flange plate to flange angles and flange angles to web, etc. Design of welded

Design of gantry girder

Design of roof trusses members for combined forces, wind loading etc. Purlin design

References:

1. Subramanian, N., –Design of steel structures‖, Oxford Higher Education
2. Duggal, S.K., –Limit state design of steel structures‖, Tata McGraw Hill 3. IS:800
4. IS: 808
5. IS: 875

DEPARTMENTAL ELECTIVE – I

PEC	DESIGN OF WASTE WATER TREATMENT SYSTEMS	DE-CE 501	3 0 0	3 CREDITS
COURSE OUTCOMES:				
CO1	Understand the characteristics of waste water.			
CO2	Design the waste water by primary sewage treatment.			
CO3	Design the waste water by secondary treatment of sewage.			
CO4	Design the sludge treatment unit of waste water.			
CO5	Understand the waste water disposal.			

Unit I

Introduction: Physical, chemical and bacteriological characteristics of wastewater, water quality standards, Composition of wastewater, Factors affecting the BOD rate of reaction, population equivalent

Introduction to Wastewater treatment and Design

Concept, treatment methods-unit operations and unit processes, treatment systems- preliminary, primary, secondary, tertiary,

Basic design considerations: Strength and characteristics of wastewater, flow rates and their function, mass loading, design criteria.

General procedure for design calculation: Objective, types of treatment units sizing of units, calculation procedure,

Unit II

Wastewater Treatment

Preliminary and primary sewage treatment: Concept, functions and Design of approach channel, equalization basin, screen chamber, grit chamber, primary sedimentation tank.

Unit III

Secondary treatment of sewage: Principles, functions and design of secondary treatment units-SST, ASP, TF, RBC, Extended aeration-oxidation ditch, aerated lagoon, waste stabilization pond.

Unit IV

Tertiary treatment: Introduction to removal of nitrogen, phosphorus, refractory organic, heavy metals, suspended solids and pathogenic bacteria.

Sludge treatment: Quantity and characteristics, concept, sludge digestion-aerobic and anaerobic, methods-sludge conditioning, dewatering, composting.

Design of sludge treatment units: Introduction, Treatment concept, Design essentials, Sludge digestion.

Unit V

Disposal of wastewater on land and water bodies,Introduction to Duckweed pond, vermiculture and root zone technologies and other emerging technologies such as UASB, Final polishing unit, River bank filtration, Zero valent iron, Phytoremediation, bioremediation, Sludge drying beds.Sewage treatment plant layout, concept of sustainable wastewater treatment.

References:

1. Sewage Disposal and Air Pollution Engineering, by S.K Garg, Khanna Publishers, 2012Wastewater Engineering and Treatment, Disposal, and Reuse by Metcalf and Eddy, Tata McGraw Hill Education
2. Environmental Engineering by H.S. Peavy, Rowe and Tchobanoglous, Tata McGraw Hill Education
3. Wastewater treatment: Concepts and design approach by G.L. Karia and R.A. Christian, Prentice Hall of India private ltd, New Delhi.

PEC	WATER QUALITY MODELING	DE-CE 502	3 0 0	3 CREDITS
COURSE OUTCOMES:				
CO1	Understand the river hydrology and flow.			
CO2	Understand the quality distribution of water.			
CO3	Identify the physical & hydrological characteristics of lake.			
CO4	Understand the sources & sinks of dissolved Oxygen.			
CO5	Introduction to water quality model. Understand about ground water.			

Unit I

Introduction: Nature of problem, nature of input, mass loading rates-point and intermittent.

River hydrology and flow: low flow frequency analysis, Morphometry (hydraulic geometry), travel time, depth and velocity estimates.

Discharge of residual matter into rivers: Assumptions, mass balance at discharge points, water quality downstream of point source, water quality response to distributed sources, effect of spatial flow variation on water quality, multiple sources-principles of superposition.

Engineering controls; Derivation of steady state stream equations

Unit II

Estuaries, bays and harbours: physical aspects of estuaries, distribution of water quality in estuaries-water quality due to point source and distributed source, derivation of estuary equation,

Unit III

Lakes: Physical and hydrologic characteristics,-evaporation, temperature stratification. **Lake wide water quality response to input**- lakes as completely mixed system, response to an impulse input, lakes in series.

Unit IV

Dissolved oxygen: Introduction, principal components of DO analysis, DO criteria and standards. **Sources and sinks of dissolved oxygen**-oxygen demanding wastes, atmospheric reaeration, photosynthesis and respiration, sediment oxygen demand, oxidation of CBOD.

DO analysis in rivers: single point source, multiple point source, distributed sources of DO and BOD

Unit V

Ground water: Subsurface processes, unsaturated zone properties, soil moisture level, flow through unsaturated porous media.

Ground water contamination: sources and causes, hydrodynamic dispersion, multiphase contamination DNAPL, NAPL, VOC, site specific ground water quality problems in India, numerical models, contaminant transport modeling

Introduction to water quality models: QUAL2E, QUAL2K, WASP4, MODFLOW, GMS.

References :

1. Surface water quality modeling and control by Thomman and Mueller, Harper Collins publishers
2. Chapra, Steven, Surface water quality modeling, McGraw Hill, New York

PEC	PLASTIC ANALYSIS OF STRUCTURES	DE-CE 503	3 0 0	3 CREDITS
COURSE OUTCOMES:				
CO1	Understand the characteristics of Plastic.			
CO2	Analyze the beam & frames.			
CO3	Understand the Semi graphical and mechanism method.			
CO4	Understand the plastic moment distribution.			
CO5	Understand the effect of axial force and shear force.			

Unit I

Introduction, Historical review, plastic failure, plastic moment, capacity of a cross-section, shape factor, concept of load factor.

Unit II

Plastic hinge and collapse Mechanisms. Analysis of beams and frames.

Unit III

Semi Graphical method and Mechanism method.

Unit IV

Plastic moment distribution for multi-storey and multi-bay frames.

Unit V

Analysis for deflections at collapse. Effect of axial force and shear.

Books:

- Plastic Analysis of Structures by P G Hodge, McGraw Hill
- Plastic Analysis and Design of steel structures by M Bill Wong
- Inelastic Analysis of Structures by M Jirasek & Z P Bazant , John Wile

PEC	STRUCTURAL FIRE ENGINEERING	DE-CE 504	3 0 0	3 CREDITS
COURSE OUTCOMES:				
CO1	Understand various characteristics of structural fire engineering.			
CO2	Identify the elements of construction for fire safety.			
CO3	Understand the architectural fire safety measures.			
CO4	Design of fire safety resistance.			
CO5	Apply fire safety.			

Unit I

Introduction to Structural Fire Engineering: Fire loads, ventilation effects, compartment geometry, Fire safety and fire-resistant tests

Unit II

Elements of construction for fire safety, protection for openings, selection of materials, site planning, Fire protection of tall buildings

Unit III

Architectural fire safety measures, Repair and rehabilitation of fire damaged structures. Non-Destructive testing, Condition survey

Unit IV

Design for Fire Resistance: Steel, Concrete. Lift design, Introduction to HVAC, Intelligent building

Unit V

Fire Safety: Urban Planning, Escape and Refuge, Internal planning, detection and suppression, Building Inspection

References:

1. Design of Fire-Resisting Structures, H.L. Malhotra, Surrey University Press 1982
2. Fire Protection Engineering in Building Design, Jane Lataille, Butterworth Heinemann 2002

PEC	ENGINEERING HYDROLOGY & FLOODS	DE-CE 505	3 0 0	3 CREDITS
COURSE OUTCOMES:				
CO1	Analyse hydro-meteorological data.			
CO2	Develop rainfall-runoff models.			
CO3	Compute yield from surface and subsurface basin.			
CO4	Introduction & Occurrence of ground water			
CO5	Formulate and solve hydrologic flood routing models.			

Unit I

Hydrologic cycle: Hydrologic cycle, water budget equation.

Precipitation: Forms, measurement, presentation, mean precipitation, missing data, error in estimation, consistency of rainfall records, IDF curve, PMP, frequency of a point Rainfall,.
Abstractions from precipitation: Factors, measurement: Infiltration, Evaporation, Evapo-transpiration

Unit II

Streamflow measurement: Measurement of stage and velocity, Stage discharge relationship

Runoff: Components and factors affecting runoff, methods of estimation of runoff volume, Rainfall – runoff relationships. SCS Method, Flow Duration Curve, Flow Mass Curve

Unit III

Hydrograph analysis: components, factors affecting hydrographs, base flow separation, Direct Runoff Hydrograph, Unit Hydrograph, Derivation of Unit Hydrograph(for an isolated storm and complex storm), S-Hydrograph, Synthetic Unit Hydrograph, Dimensionless unit hydrograph ,IUH

Unit IV

Introduction , occurrence of Ground Water -Unsaturated and saturated zone,aquifer properties ,Basic equation of Ground water movement, flow through a confined aquifer and unconfined aquifer,Well loss and specific capacity, Estimation of hydraulic conductivity, transmissivity and storage coefficient.

Unit V

Flood: Introduction estimation of flood, Rational method flood frequency studies, Gumbel's method, Log - Pearson type III distribution, Design Flood, Design storm, Risk, Reliability and safety factor, flood control in India and Flood Forecasting
Flood Routing: : Introduction and categories, Hydrologic and Hydraulic Routing, Hydraulic

channel Routing, Muskingam Method, Hydrologic storage routing, Modified Puls Method, Good rich Method.

References:

1. Open Channel Hydraulics by Ven Te Chow, McGraw Hill International Book Company
2. Engineering Hydrology by Subramanya, K., 2nd edition, Tata McGraw Hill publishing Co.ltd., New Delhi
3. Rajesh Srivastava and Ashu Jain, McGraw Hill Eductaion(I) Pvt. LTD,Chennai

DEPARTMENTAL ELECTIVE – II

PEC	**PLANNING AND MANAGEMENT OF**	**DE-CE 601**	**3 1 0**	**4 CREDITS**

	BUILDINGS			
COURSE OUTCOMES:				
CO1	Identify the components of urban forms.			
CO2	Understand the function planning of buildings.			
CO3	Design of public buildings.			
CO4	Understand the fire resistance.			
CO5	Apply the engineering services in buildings.			

Unit I

Components of urban forms and their planning, concept of neighbourhood unit, street system and layout in neighbourhood

Unit II

Functional Planning of Buildings: Principles of planning, factors - aspect, prospect, privacy, grouping, roominess, water supply and sanitation, flexibility, circulation

Unit III

Planning and design of public buildings such as residential, offices, schools, hospitals, theatres, and industrial buildings, preliminaries of vastu

Unit IV

Standard fire, fire list, fire resistance, classification of buildings, means of escape, alarms. Fire hydrants, design criteria of fire hydrant system

Unit V

Engineering Services in a Building as a System: Lifts, escalators, cold and hot water systems, water supply system, wastewater collection systems, electrical system

References:

1. Building Planning and Drawing by Dr.N.Kumara Swamy and A. Kameswara Rao, Charotar publishers, Anand.
2. Building Drawing by Shah, Kale and Patki, Tata McGraw Hill Education
3. Instructional Sketches for Civil Engineering Drawing – A series & B series.
4. Building Planning and Design and Scheduling by Gurucharan Singh & Jagadish Singh, Standard Publishers and Distributors.

PEC	WIND AND SEISMIC ANALYSIS	DE-CE 602	3 1 0	4 CREDITS
COURSE OUTCOMES:				
CO1	Understand basic features of Water Supply in Rural areas.			
CO2	Analyze Different Sources of water available for rural areas.			
CO3	Learn about the different methods available for rural sanitation.			
CO4	Understand Solid waste management in rural areas in India.			

Unit I

Introduction: Objective, scope and outcome of the course

Structural Systems: Types of structures and Structure's forms, Symmetry and Asymmetry in building forms, Vertical and lateral loadresting elements, shear walls, framed tubes and various multi- storey configurations.

Unit II

DesignLoads: various types of loads and relevant codes. Design loads for different types of buildings. (IS-875 part 1 & 2) & Load Flow Concept

Unit III

Wind Loads Analysis: Wind loads & calculation of wind load on flat roof, pitched roof and single sloped roof buildings (IS: 875-Part 3).

Unit IV

Earthquake Load Analysis: Earthquake loads & calculations of earthquake loads on framed structures. (IS: 1893 – Part 1).

Unit V

Earthquake Resistant Construction: Typical seismic failure of masonry and RCC structures.Earthquake resistant construction of buildings, and various provisions as per IS codes; IS-4326,IS-13827, IS-13828, IS-13920, IS-13935.

PEC	RURAL WATER SUPPLY	DE-CE 603	3 1 0	4 CREDITS
COURSE OUTCOMES:				
CO1	Understand basic features of Water Supply in Rural areas.			
CO2	Analyze Different Sources of water available for rural areas.			
CO3	Learn about the different methods available for rural sanitation.			
CO4	Understand Solid waste management in rural areas in India.			

Unit-1

Rural Water Supply: Issues of rural water supply –Various techniques for rural water supply-merits- National rural drinking water program- rural water quality monitoring and surveillance-operation and maintenance of rural water supplies.

Low Cost water Treatment: Introduction – Epidemiological aspects of water quality methods for low cost water treatment - Specific contaminant removal systems

Unit-2

Rural Sanitation: Introduction to rural sanitation- Community and sanitary latrines - Planning of wastewater collection system in rural areas- Treatment and Disposal of wastewater - Compact and simple wastewater treatment units and systems in rural areas stabilization ponds - septic tanks - Imhoff tank- soak pits- low cost excreta disposal systems Effluent disposal. Identify problems pertaining to rural water supply and sanitation. Design water supply and sanitation system for rural community.

Unit-3

Industrial Hygiene and Sanitation: Occupational Hazards- Schools- Public Buildings-Hospitals-Eating establishments- Swimming pools – Cleanliness and maintenance and comfort- Industrial plant sanitation.

Unit-4

Solid Waste Management: Disposal of Solid Wastes- Composting- land filling incineration- Biogas plants - Rural health - Other specific issues and problems encountered in rural sanitation.

Note: The students should be given a comprehensive problem at the end which requires inputs/ knowledge/ application from all the units of the syllabus. It may be evaluated as a part of TAQ•

References:

1. 'Water Treatment and Sanitation – Simple Method for Rural Area' by Mann H.T. and Williamson D.

2. Operation and maintenance of rural water supply and sanitation systems by Brikké F

3. 'Water Supply for Rural Areas & Small Communities' by Wanger E.G. and Lanoix J.N.,

4. WHO 'Water Supply and Sewerage', by E.W.Steel & T.J.Mcghee,McGraw Hill.

5. 'Manual on Water Supply and Treatment', CPHEEO, Ministry of Urban Development, Govt. of India.

PEC	COMPUTER AIDED STRUCTURAL ENGINEERING	DE-CE 604	3 1 0	4 CREDITS
COURSE OUTCOMES:				
CO1	Apply the computer in design.			
CO2	Analyze the beam using stiffness method.			
CO3	Understand database.			
CO4	Understand the MATLAB software & applying its application.			
CO5	Understanding the various software for design of structure.			

Unit I

Introduction to computer aided design- Reasons for implementing CAD- Design Process- Applications of computer to design- Benefits of computer aided design.

Unit II

Stiffness method: Microsoft Excel procedure for stiffness method of analysis step by step procedure using Excel.

Analysis of beams using stiffness method: Long hand solution of single span beams, continuous beam solution of single span beams using Excel.

Unit III

Database: Introduction, concept of database, objectives of database, design database.

Unit IV

Introduction to MATLAB and its application

Unit V

Introduction to various softwares for design of structures, water & sewerage systems etc.

References :

1. C.S. Krishna Murthy & Rajiv S. – Computer Aided Design, Software & Analytical tools- Narosa publishing house, India.
2. Computer Aided Design for Reinforced Concrete – Dr. L Shah- Structures publishers, Pune
3. IS- 456- 2000
4. Jain, A. –Limit State Design‖, Nem Chand & Bros. Roorkee
5. Computer Application – Boyd C. Panbou, Mc. Graw Hill 1997
6. Raker D., and Rice H, Inside Auto CAD, BPD Publication, Delhi 1986
7. Nancy Andrews – Windows the official guide to Microsoft Operation Environmental, Micro Soft, 1986
8. Moshi F., Rubinstein, Matrix Computer Analysis of Structures, Prentice Hall 1986

PEC	GEO ENVIRONMETAL & GEO HAZARD ENGINEERING	DE-CE 605	3 1 0	4 CREDITS
COURSE OUTCOMES:				
CO1	Identify surface contamination control and remediation.			
CO2	Understand about landfills.			
CO3	Understanding Geotechnical earthquake.			
CO4	Understanding landslides.			
CO5	Identify geo hazards & apply various ground improvement techniques.			

Unit I

Geo-environmental engineering, waste generation, subsurface contamination, waste containment, sub surface contamination control and remediation.

Unit II

Landfills: types of landfills, design of landfills-siting criteria, waste containment principles, types of barrier material, operation of landfills.

Engineering properties and geotechnical reuse of waste material such as coal ash, mining waste, and demolition waste, Ash ponds. Reclamation of old waste dumps

Unit III

Geotechnical earthquake engineering: Engineering seismology, strong ground motion, seismic hazard analysis, local site effects and design of ground motions, liquefaction hazard evaluation and remedial measures

Unit IV

Landslides: Causes and phenomenon associated with liquefaction, effect of rainfall on slope stability, earthquake triggered landslides, landslide prevention, control and remedial measures-soil nailing, gabions, drainage

Unit V

Other hazards: Ground subsidence, ground heave, erosion,unstable slopes

Ground improvement: Shallow stabilization with additives, Deep stabilization and column, vibro-floatation, dynamic compaction.

References:

1. Geotechnical practices for waste disposals- D.E. Daniel (ed) (1973), Springer science + Business media, B.V
2. Design construction and monitoring and landfills by A.Bagchi (1974), Wiley 1994
3. Engineering with Geosynthetics by G.V. Rao and G.V.S.S. Rau (1992)
4. Environmental aspects of construction and waste material by J.J.M. Goumans, H.A. Vanderstoot and T.S. Albert.
5. Geotechnology of waste management by I.S. Oweis and R.P. Khera, Butterworths 1990

DEPARTMENTAL ELECTIVE –III

PEC	PRE STRESSED CONCRETE DESIGN	DE-CE 701	3 0 0	3 CREDITS
COURSE OUTCOMES:				
CO1	Understand the basic properties of pre-stressed concrete constituents.			
CO2	Analyze the flexural behavior of simple and composite pre-stressed concrete girders.			
CO3	Design the prestressed concrete sections.			
CO4	To acquire knowledge in knowing Analysis for stress of composite pre-stressed concrete girders for flexure using limit state design procedures			
CO5	Understand the optimization techniques & apply on prestressed concrete structure.			

Unit I

Introduction: Basic concepts of prestressing, advantages and applications of prestressed concrete.

Materials for prestressed concrete: high strength concrete, permissible stresses in concrete, high strength steel, permissible stresses in steel

Prestressing Systems:Prestensioning and post tensioning systems, methods of prestressing

Losses of Prestress : Types of losses of prestress, loss due to elastic deformation of concrete, loss due to shrinkage of concrete, loss due to creep of concrete, loss due to relaxation of stress in steel, loss due to friction, loss due to anchorage slip, total loss in pre-tensioned and post tensioned members.

Unit II

Analysis of Prestress and Bending Stresses: Basic assumptions, analysis of prestress, resultant stresses at a section, concept of load balancing, stresses in tendons, cracking moment.

Deflections: Importance of control of deflections, factors influencing deflections, short term deflections of un-cracked members, deflections of cracked members, prediction of long term deflections.

Shear and Torsional Resistance: Ultimate shear resistance of prestressed concrete members, prestressed concrete members in torsion, design of reinforcements for torsion, shear and bending.

Unit III

Design of Prestressed Concrete Sections: Dimensioning of flexural members, design of pre-tensioned and post tensioned beams, design of partially prestressed members, design of one way and two way slabs, continuous beams. Design for axial tension, compression and bending, bond and bearing.

Unit IV

Limit State Design: Review of limit state design concepts, criteria for limit state, design loads and strengths, strength and serviceability in limit state, crack widths in prestressed members, principles of dimensioning prestressed concrete members.

Unit V

Introduction to Optimum Design of Prestressed Concrete Structures:Principles of optimization, methods of optimization, optimization techniques, application to prestressed concrete structures.

References:

1.Raju, N.K., –Prestressed Concretel. McGraw Hill Education 2.IS:1343-2012

PEC	ANALYSIS AND DESIGN OF HYDRAULIC STRUCTURES	DE-CE 702	3 0 0	3 CREDITS
COURSE OUTCOMES:				
CO1	Understand the principle, design and types of head work.			
CO2	Identify the location and layout of head works. Understand the cross drainage works.			
CO3	Understand about flood routing and earth dams.			
CO4	Understand the force analysis & factor of safety in Gravity Dams.			
CO5	Design the layout of power house and identify the design criteria of hydraulic jump. Evaluate the essential requirements of the most widely used spillways and design coefficient stilling basins by following I.S. recommendations.			

UNIT – I

Types of Head works: Component parts of a diversion headwork, Failure of hydraulic structures founded on permeable foundations, Principles of design, Bligh's theory, Khosla's theory for determination of pressure and exit gradient.

Regulation Works: Falls, Classification, Introduction to design principle of falls, Design of Sarda type and straight glacis tall.

Principle and design of Distributory head regulator and cross regulator, canal escape, Bed bars.

UNIT – II

Canal head works: Functions, Location and Layout of head works. Weir and Barrage, Canal head Regulator, Introduction to the design principles of Weirs on permeable foundations, Design of vertical drop and sloping glacis weir.

Cross drainage works: Necessity and types. Aqueduct, Siphon Aqueduct, super passage, canal siphon, level crossing, Introduction to design principles of cross drainage works.

UNIT – III

Flood routing: Types, methods of reservoir routing, channel routing by Muskingham Method.

Investigation and planning of dams and Reservoirs: Zones of storage, Estimation of storage

capacity, Reservoir losses, Reservoir sedimentation and its control, life of a reservoir. Dams: classification and selection criteria.
Earth Dams: Classification, causes of failure Phreatic line, and its determination Introduction to stability analysis.

UNIT – IV
Gravity dams: Forces method of analysis, modes of failure and factor of safety, Elementary profile, stability analysis, galleries, joints, control of cracks.

UNIT – V
Spillways: Spillway capacity, types of spillways, Design of ogee spillway, Energy dissipation below spillway, Design criteria for Hydraulic Jump type stilling basins with horizontal and sloping aprons, spillway gates. Hydro-Electric Power: assessment of potential specially in reference to India, classification of power plants, important terms, types of turbines and their suitability. Power House layout and important structures of a powerhouse.

Text Books
1. Water Resources Engg. By Larry W Mays, John Wiley India
2. Water resources Engg. By Wurbs and James, John wiley India
3. Water Resources Engg. By R.K. Linsley, McGraw Hill
4. Irrigation and Water Resources Engg. By G L Asawa, New age International Publishers

References
5. Irrigation Engg. And Hydraulic Structures by S. K. Garg, Khanna Publishers

6. Irrigation and Water Power Engineering by B. C. Punimia & Pande B.B. Lal

PEC	TRANSPORTATION SYSTEM & PLANNING	DE-CE 703	3 0 0	3 CREDITS
COURSE OUTCOMES:				
CO1	Understand the traffic problems associated with cities and role of transportation system.			
CO2	Describe type of transportation systems and their properties.			
CO3	Learn four stages modeling for travel demand.			
CO4	Explain the standards required for the construction of pedestrian, bicycle and parking facilities.			
CO5	Describe the importance of long term planning, short term planning and use of ITS in transportation			

Unit I

Introduction**:** Overview of transportation system, nature of traffic problems in cities, Present Scenario of road transport and transport assets. Role of transportation: Social, Political, Environmental, Goals and objectives of transportation planning.
Type of transportation system**:** Intermediate Public Transport (IPT), Public Transport, Rapid and mass transport system. Traffic Flow and traffic stream variables.

Unit II

Current practice and methods for data collection and analysis, performance evaluation, Travel demand**:** Estimation and fore casting, trip classification, trip generation: factors and methods, multiple regression analysis.

Unit III

Trip distribution methods, modal split, trip assignment. Use of software for transport planning

Unit IV

Evaluation of transport planning proposals**:** Land Use Transport Planning, Economic Evaluation methods, net-present-Value methods, Benefit Cost method, Internal rate of return method.

Unit V

Transportation Facilities**:** Pedestrian facilities, Bicycle facilities, parking and terminal facilities. Transport system management. Long term and short-term planning, use of IT in transportation.

References:

1. AdibKanafani.(1983). Transportation Demand Analysis. Mc Graw Hill Series in Transportation, Berkeley.
2. Hutchinson, B.G. (1974). Principles of Urban Transport Systems Planning. Mc Graw Hill Book Company, New York.
3. John W.Dickey. (1975). Metropolitan Transportation Planning. Mc Graw Hill Book Company, New York.
4. Papacostas, C.S., and Prevedouros, P.D. (2002). Transportation Engineering and Planning. 3rd Edition, Prentice - Hall of India Pvt Ltd., 318-436

PEC	BRIDGE ENGINEERING	DE-CE 704	3 0 0	3 CREDITS
COURSE OUTCOMES:				
CO1	Remember the different design philosophies of the highway and railway bridges.			
CO2	Understand the structural behavior of different components of a RCC and steel bridge.			
CO3	Apply the techniques, skills, and modern engineering tools in steel bridges.			
CO4	Understand about the suspension & cantilever bridges.			
CO5	Analyze the design forces, bearings of the joints. Apply the maintenance.			

Unit I

Introduction: Definition, components of a bridge, classifications, importance of bridges. Investigation of Bridges: Need for investigations, selection of bridge site, preliminary data to be collected, design discharge and its determination, linear waterway, economical span, vertical clearance above H.F.L., scour depth, choice of bridge type.

Unit II

Standard specifications for road and railway bridges.

R.C.C. Bridges: Slab culvert, skew slab culvert, T – beam bridge, prestressed concrete bridges

Unit III

Steel Bridges: Plate girder and truss bridges

Unit IV

Introduction to suspension bridges, cantilever bridges, cable – stayed bridges and Prestressed concrete Bridges

Unit V

Sub-structure: Types of piers and abutments, design forces, design of piers and abutments.

Bearing and joints, construction, inspection and maintenance of bridges.

References :

- Victor, D.J., –Essentials of bridge eng ineering‖, Oxford & IBH Publishing co., New Delhi
- Ponnuswamy, S., –Bridge Engineering‖, McGraw Hill Education
- IRC 24-1967 –Standard specifications and code of Practice for road bridges, Section II, Steel Road Bridges, I.R.C. New Delhi.
- IRC 5-1998 –Standard specification and code of Practice for road bridges – General Features of Design‖

PEC	SOIL DYNAMICS	DE-CE 705	3 0 0	3 CREDITS
COURSE OUTCOMES:				
CO1	Understand the theory of Vibration & dynamic earth pressure.			
CO2	Identify the dynamic soil properties & earth pressure.			
CO3	Identify the strong ground motion & vibration of elementary systems.			
CO4	Apply Dynamic soil testing techniques.			
CO5	Identify the guidelines for design and construction of machine foundation.			

Unit - I

Theory of vibrations: Introduction, periodic motion, classical theory, free and forced vibration, energy dissipation mechanism,

Dynamics of elastic system: Introduction, Vibrations of two degree and multi degree system, vibration of beams and plates on elastic foundation, dimensional analysis.

Unit II

Dynamic soil properties: Introduction, representation of stress condition by Mohr circle and stress path, dynamic stress-strain relationship, Determination of dynamic soil properties, shake table testing, behaviour of soil on pulsating load.

Dynamic earth pressure: Introduction, classical theory for static earth pressure, dynamic earth pressure theory, displacement analysis, recommendation of Indian Standard code of practice

Unit III

Strong ground motion: Introduction, Strong motion observation studies, strong motion measurement, characteristics of strong ground motion.

Vibration of elementary Systems: Vibration motion, vector representation of harmonic motion, Single degree of freedom system: Free Vibrations- damped and undamped, Forced Vibrations – damped and undamped.

Unit IV

Dynamic soil testing techniques: cyclic plate load test, block vibration test, shear modulus test, geophysical methods, Resonance- column test, Two & three borehole techniques, Model tests using centrifuge and shake table, recent developments

Vibration isolation and control: vibration transmitted through soil media, active and

passive isolation, vibration isolation – rigid foundation and flexible foundation, method of isolation, properties of material and media used for isolation, vibration control of existing machine, foundation isolation by barriers.

Unit V

Guidelines for design and construction of machine foundation: data required for design of reciprocating, impact and rotary type machines, guidelines for the design of different type machines, construction guidelines, guidelines for providing vibration absorbers. Barken's approach, Ford & Haddow's analysis, Hammer foundation, I. S. Codes

References :

1. S. Prakash – Machine Foundation. Tata McGraw Hill Education
2. B. B. Prasad – Fundamentals of Ground Vibration PHI Learning (P) Ltd. New Delhi
3. Richard, Hall and Wood – Vibrations of Soil and Foundations Dept. of Civil Engg University of Michigan 1968
4. Fundamental of Soil dynamics and earthquake engineering, PHI, By Bharat Bhushan Prasad, PHI New Delhi.

DEPARTMENTAL ELECTIVE –IV

PEC	ADVANCE PAVEMENT DESIGN	DE-CE 801	3 1 0	4 CREDITS
COURSE OUTCOMES:				
CO1	Characterize the response characteristics of soil, aggregate, asphalt, and asphalt mixes.			
CO2	Analyze flexible pavements using CBR Method			
CO3	Understand a rigid pavement.			
CO4	Design a rigid pavement using IRC, and AASHTO methods			
CO5	Evaluate various pavement methods.			

Unit -I

Equivalent Single Wheels Load concepts and applications, Relationship between wheel arrangements and loading effects, tyre contact area, Effect of load repetition, Effect of transient loads, Impact of moving loading, Factors to be considered in Design of pavements, Design wheel load, soil, climatic factors, pavement component materials, Environmental factors, Special factors such as frost, Freezing and thawing.

Unit -II

Flexible Pavements : Component parts of the pavement structures and their functions, stresses in flexible pavements, Stress distribution through various layers, Boussinesque's theory , Burmister's two layered theory, methods of design, group index method, CBR method, Burmister's method and North Dakota cone method.

Unit -III

Rigid Pavements: Evaluation of subgrade, Modulus-K by plate bearing test and the test details, Westergaard's stress theory stresses in rigid pavements, Temperature stresses, warping stresses, frictional stresses, critical combination of stresses, critical loading positions.

Unit -IV

Rigid pavement design: IRC method, Fatigue analysis, PCA chart method. AASHTO Method, Reliability analysis. PAVEMENT JOINTS: Types of joints, contraction and warping joints, dowel bars and tie bars, Temperature reinforcements, filling and sealing of joints.

Unit -V

Evaluation and Strengthening of Existing Pavements: Benkleman beam method, Serviceability Index Method. Rigid and flexible overlays and their design procedures.

Reference Books:--

1. Principles of pavement design by E.J.Yoder & M.W. Witczak
2. AASHO, "AASHO Interim Guide for Design of Pavement Structures", Washington, D.C.
3. Portland Cement Association, Guidlines for Design of Rigid Pavements, Washington
4. DSIR, Conc. Roads Design & Construction
5. Srinivasan M. "Modern Permanent Way"

PEC	OPEN CHANNEL & RIVER HYDRAULICS	DE-CE 802	3 1 0	4 CREDITS
COURSE OUTCOMES:				
CO1	Differentiate between open channel flow and pipe flow			
CO2	Estimate forces acting in open channel flow			
CO3	Requirement of efficient channel section and design procedure for efficient channel section			
CO4	Understand the characteristics of varied flow			
CO5	Understand the sediments properties.			

Unit I

Gradually varied flow: Differential equation governing GVF, Classification analysis and control sections of flow profiles, Computation of GVF profiles by different methods. Rapidly varied flow: Types, Analysis and characteristics of Hydraulic jump in rectangular and non-rectangular channels, Location of jump, Introduction to jump in non- rectangular channels and on sloping floor, Use of jump as Energy dissipater.

Unit II

Introduction to OCF, Uniform flow, GVF, RVF, Dynamics of SVF – increasing and decreasing discharge, classification of SVF Profiles, Numerical Methods of solutions, Computation of profiles with increasing and decreasing discharge, side weirs, flow through bottom racks.

Unit III

Flow in channels of nonlinear alignment, introduction spiral flow, super elevation, cross waves, design of flow in channels of nonlinear alignment, bends, Application of energy and momentum principle to non-prismatic channels, computation of flow profiles in non-prismatic channels, design of transition, culverts

Unit IV

Fluvial hydraulics, sediment transport, mode of sediment motion and bed formation, threshold movement, total sediment load, suspended and bed load theories, reservoir sedimentation

Unit V

Sediment properties

Incipient sediment motion of uniform and non-uniform sediments, stable channel design

Flow resistance and bed form regimes Bed loads, suspended loads and total load,

Sediment sampling, stable channel design, sediment control, aggradation, degradation, sediment discharge,Local scour around hydraulic structure and scour protection

Reference:

1. Yang C.T. Sediment transport – theory and practice, international edition, McGraw Hill

1996
2. Stern T.W., open channel hydraulics, international edition, Mcgraw Hill 1996 2001
3. R.J. Girde and K.G. Rangarajan – Mechanics of sediment transport New Age Publications, New Delhi
4. Flow in Open Channel – K. Subramanya (Tata McGraw Hill)

PEC	GROUNDWATER MANAGEMENT	DE-CE 803	3 1 0	4 CREDITS
COURSE OUTCOMES:				
CO1	Understand the hydrologic cycle and about the porous media which is responsible for ground water improvement.			
CO2	Learn the methods to extract the water from ground			
CO3	Develop and design of well and monitor recharge capacity as well as efficiency of well.			
CO4	Understand the quality& exploration of ground water.			
CO5	Understand the Ground water management techniques.			

Unit-1

Introduction, hydrological cycle & definitions, Occurrence of ground water, hydro-geology & aquifers, Ground water movement, Darcy's law, flow-nets in isotropic medium.

Unit-2

Steady and unsteady flow through confined and unconfined aquifers, Dupuits theory, Observation wells, Well Hydraulics: Single& Multiple well system, partially penetrating wells, Image wells, Mutual interference of wells, well losses, specific capacity, Inverse problem i.e. pumping tests for aquifer parameters.

Unit-3

Water Wells: Design of water wells, Well construction, Well completion, Development of wells Pumping equipment for water wells, maintenance of wells, ground water irrigation.

Unit-4

Ground Water quality, Contamination of groundwater and its Control, Ground Water Modeling Techniques, Ground water exploration, Surface and Subsurface Investigations of Ground water, Artificial discharge and Recharge of Ground Water, Groundwater drainage.

Unit-5

Ground Water Management Techniques: Groundwater budgeting, groundwater modeling & stimulation, application of GIS and remote sensing in groundwater management. roof-top rainwater harvesting and recharge.

Recommended References:

- *'Groundwater Hydrology' by Todd D. K.*
- *'Groundwater Resource Evaluation' by Walton W. C.*
- *'Groundwater' by Raghunath H. M.*
- *'Handbook of Applied Hydrology' by Chow V. T.*
- *'Irrigation: Theory & Practice' by Michael A. M.*
- *'Groundwater' by S.Ramakrishnan*

PEC	DESIGN OF MASONRY, TIMBER AND ALUMINIUM STRUCTURES	DE-CE 804	3 1 0	4 CREDITS
COURSE OUTCOMES:				
CO1	Able to design the walls and columns with and without eccentricity			
CO2	Understand the stability of masonry dams and retaining walls			
CO3	Familiarize in the basic concepts of limit state design			
CO4	Gain knowledge in design of timber structures			
CO5	Know the purpose, procedures for the connections in Aluminum structures			

Unit I
MASONRY WALLS AND COLUMNS
Axially loaded square and rectangular columns with uniaxial eccentricity – Solid walls – Load bearing walls – axially loaded – eccentrically loaded walls with openings – Non load bearing walls

Unit II
LATERALLY LOADED MASONRY STRUCTURES
Structures and loads – stability of masonry – middle third rule – Masonry dams – Trapezoidal dams – Retaining walls.

Unit III
LOAD DISTRIBUTION ELEMENTS
Bed blocks – spread footings for walls and columns – area based on safe bearing capacity. Design of Reinforced Masonry Introduction – basic concepts – limit state design of reinforced brick masonry – lintels – axially loaded columns – Design of cavity walls.

Unit IV
TIMBER STRUCTURES
Factors affecting the strength – permissible stresses – Design for bending, shear and bearing - Flitched beams – solid and built up columns – combined bending and direct stress –

application to form work.

Unit V

ALUMINIUM STRUCTURES

Introduction, Stress-Strain Relationship - Permissible Stresses - Tension and Compression Members, Laced and Battened Columns, Beams, Riveted and Bolted Connections.

TEXT BOOK

1. Arya A.S., Structural Design in Steel, Masonry and Timber, Nemchand and Bros., Roorkee, 1987.

REFERENCE BOOK

1. Dayarathnam P., Bricks and Reinforced Brick Structures, Oxford & IBH Publishing Co., New Delhi, 2000.

PEC	MATRIX METHOD OF STRUCTURAL ANALYSIS	DE-CE 805	3 1 0	4 CREDITS
COURSE OUTCOMES:				
CO1	Understand about the structures.			
CO2	Understand the Mathematical preliminaries and Trusses.			
CO3	Analyze the beams.			
CO4	Analyze of plane frames.			
CO5	Understand Finite element method.			

Unit I

Introduction Structures, loads and response; determinate and indeterminate structures; stiffness and

Review of analysis of indeterminate structures: Force and displacement methods

Unit II

Mathematical preliminaries: Review of concept of matrix algebra; stiffness and flexibility matrices

Analysis of Trusses

Unit III

Analysis of Beams

Unit IV

Analysis of plane frames

Implementation issues

Unit V

Beyond matrix method: Introduction to finite element method

References:

- S.S. Rao Finite Element Method in Engineering Butterworth-Heinemann (2011)

DEPARTMENTAL ELECTIVE –V

PEC	ADVANCED CONCRETE TECHNOLOGY	DE-CE 806	3 1 0	4 CREDITS
COURSE OUTCOMES:				
CO1	Understand the fundamentals of concrete technology.			
CO2	Understand about special concrete			
CO3	Apply the special construction method.			
CO4	Identify the repair, rehabilitation and Enhancement of concrete.			
CO5	Understand the durability of concrete.			

Unit I

Fundamental Concrete Technology: Mixing, transportation, placing and curing of concrete, properties of fresh and hardened concrete, use of chemical and mineral admixtures.

Unit II

Special Concrete: Properties and applications of: High strength - high performance concrete, reactive powder concrete. Lightweight, heavyweight, and mass concrete; fibre reinforced concrete; self-compacting concrete; shotcrete; other special concretes.

Unit III

Special Construction Methods: Mechanical construction, roller compaction and shotcreting, preplaced aggregate and anti washout concrete.
Special Concrete methods: Ready mixed concrete, grouting, sprayed concrete, under water concrete

Unit IV

Repair, Rehabilitation and Enhancement of Concrete: Durability problems in concrete, masonry and steel structures, NDT and partially destructive test methods, repair methodology –principles and practices, concept of residual life and whole life cycle costing, perspective and preventive maintenance.

Unit V

Durability of Concrete: Introduction to durability; relation between durability and permeability. Chemical attack of concrete; corrosion of steel rebars; other durability issues.

References:

1. P.K.Mehta and Paulo J.M.Monteiro, "Concrete: microstructure, properties and materials", The McGraw-Hill Companies
2. AM Neville, Properties of concrete, Pearson
3. ML Gambhir, Concrete Technology, Tata McGraw Hill Companies
4. AR Santakumar, Concrete Technology, Oxford University Press

PEC	SOLID WASTE MANAGEMENT	DE-CE 807	3 1 0	4 CREDITS
COURSE OUTCOMES:				
CO1	Understand municipal solid waste management systems with respect to its physical properties and associated critical considerations in view of emerging technologies.			
CO2	Select the appropriate method for solid waste collection, transportation, redistribution and disposal.			
CO3	Identify the Solid waste characterization & Waste processing.			
CO4	Understand the knowledge about Biomedical waste generation and disposal methods.			
CO5	Describe methods of disposal of hazardous solid waste.			

Unit I

Introduction: Objective, scope and outcome of the course.

Introduction to SWM: Definition of waste and solid waste, classification solid waste, sources of solid waste, its composition, factors affecting waste generation, traditional methods of waste collection and disposal.

Unit II

Waste Collection: Components of waste collection, waste collection containers, their characteristics, types, waste collection vehicles, collection frequency, collection route, transfer stations.

Unit III

Solid Waste Characterization: Physical characteristics, chemical characteristics and biological characteristics of solid wastes.

Waste Processing: Size reduction, factors affecting size reduction, size reducing equipment, volume reduction, equipment for volume reduction, waste minimization, waste hierarchy, 3 R principle.

Unit IV

Hazardous Waste: Definition, sources, classification, collection, segregation, treatment and disposal methods

Radioactive Waste, E-Waste, Biomedical Waste: Definition, sources, classification, segregation, management and disposal methods

Unit V

Treatment and Disposal of Solid Waste: Composting, vermicomposting, biogas production, thermal treatment, incineration, pyrolysis, gasification, biological treatment, Sanitary land filling, land fill leachate and gas management

Latest Advances and Rules related to SWM, Hazardous Waste, Plastic Waste and E-Waste Management

References

1. Iqbal H. Khan & Naved Ehsan, A text book of Solid Waste Management, CBS Publ.
2. Tchobanoglous, G., Theisen, H., & Vigil, S.A; Integrated Solid Waste Management: McGraw Hill,New York
3. Solid Waste Engineering, Principle & Management issues by Ven Te Chow
4. Bhide, A.D., B.B. Sundaresan, Solid Waste Management in developing countries.
5. Manual on Municipal solid Waste Management, CPHEEO, Govt. of India.
6. Guidelines for Management and Handling of Hazardous wastes MOEF (1991), Govt. of India.
7. Datta, M; Waste Disposal in Engineered Land fills, Narosa Publishers, Delhi.
8. Waste Management "Asian and Pacific Center for Transfer of Technology (N.D.) India", September 1993.

PEC	DOCKS AND HARBOUR ENGINEERING	DE-CE 808	3 1 0	4 CREDITS
COURSE OUTCOMES:				
CO1	To understand the various elements of Harbour Engineerimg.			
CO2	To understand the natural phenomena of Harbour Engineering.			
CO3	To understand the fundamentals of planning and design of various marine structures			
CO4	To understand the Docks & Locks.			
CO5	To understand the Port amenities & Navigational Aids.			

Unit I

General: History of water transportation at world level and at national level development and policy, classification of harbours, natural and artificial. Major ports in India, administrative set up.

Harbour Planning: Harbour components, ship characteristics, characteristics of good harbour and principles of harbour planning, size of harbour, site selection criteria and layout of harbours. Surveys to be carried out for harbor planning**.**

Unit II

Natural Phenomena: Wind, waves, tides formation and currents phenomena, their generation characteristics and effects on marine structures, silting, erosion and littoral drift.

Unit III

Marine Structures: General design aspects, breakwaters - function, types general design principles, wharves, quays, jetties, piers, pier heads, dolphin, fenders, mooring accessories – function, types, suitability, design and construction features.

Unit IV

Docks and Locks: Tidal basin, wet docks-purpose, design consideration, operation of lock gates and passage, repair docks graving docks, floating docks.

Unit V

Port Amenities and Navigational Aids: Ferry, transfer bridges, floating landing stages, transit sheds,

warehouses, cold storage, aprons, cargo handling equipments, purpose and general description, Channel and entrance demarcation, buoys, beacons, light house electronic communication devices.

Reference Books:

1. Dr. S. K. Khanna, M.G.Arora and S.S. Jain, Airport Planning & Design, Nem Chand & Bros.,Roorkee
2. G.V. Rao Airport Engineering, Tata McGraw Hill Pub. Co., New Delhi
3. R. Srinivasan and S. C. Rangwala, Harbour, Dock and Tunnel Engineering, 1995, Charotar Pub.House, Anand
4. S. P. Bindra, A Course in Docks and Harbour Engineering, 1992, DhanpatRai& Sons, NewDelhi
5. Airport Engineering, Charotar Publishing House Pvt. Ltd, Anand

PEC	**Industrial Pollution Control and Environmental Audit**	**DE-CE 809**	**3 1 0**	**4 CREDITS**

COURSE OUTCOMES:	
CO1	Identify the Industrial Pollution sources and its characteristics.
CO2	Identify the pollutants in Industrial waste water.
CO3	Understand the different techniques used for Particulate and Gaseous Pollutant Control in different Industries. Understand the knowledge about solid waste generation and disposal methods.
CO4	Apply the recent trends in industrial waste management.
CO5	Analyze Environmental audit process.

Unit-1
Industrial wastes & their sources: various industrial processes, sources and types of wastes-solid, liquid, gaseous, noise & radiation emissions. Sources for industrial water usages and various industrial processes requiring water use and water quality.

Unit-2
Processes responsible for deterioration in water quality, Various waste water streams, Control and removal of specific pollutants in industrial wastewaters, e.g., oil and grease, bio-degradable organics, chemicals such as cyanide, fluoride, toxic organics, heavy metals, radioactivity etc. Wastewater re-uses & recycling, concept of zero discharge effluent.

Unit-3
Control of gaseous emissions: hood and ducts, tall stacks, particulate and gaseous pollutant control; Solid waste generation and disposal management; Hazardous wastes: definitions, concepts and management aspects; Noise & radiation: generation, control and management.

Unit-4
Recent trends in industrial waste management, cradle to grave concept, life cycle analysis, clean technologies; Case studies of various industries, e.g., dairy, fertilizer, distillery, sugar, pulp and paper, iron and steel, metal plating, thermal power plants, etc.

Unit-5
Environmental audit: definitions and concepts, environmental audit versus accounts audit, compliance audit, relevant methodologies, various pollution regulations, Introduction to ISO and ISO 14000.

Recommended References:
1. Industrial Wastewater Management Handbook, Azad, Hardom Singh, Editor-in-Chief, McGraw Hill, New York.
2. Wastewater Reuse and Recycling Technology-Pollution Technology Review-72, Culp, Gordan, George Wasner, Robert Williams and Mark , V.Hughes Jr., Noyes Data Corporation, New Jersey.
3. The Treatment of Industrial wastes. Edmund, B. Besselieve P.E., McGraw Hill, New York.
4. Industrial Pollution Control –Issues and Techniques. Nancy, J. Sell, Van Nostrand Reinhold Co, NY.

5. Wastewater Engineering: Treatment & Re-use. Metcalf & Eddy, Tata Mc Graw-Hill.
6. Industrial Pollution Prevention Handbook. Shen, T.T., Springer-Verlag, Berlin.
7. Environmental Engineering. Pandey, G.N. and Corney, G.C., Tata McGraw Hill, New Delhi
8. Environment (protection) Act- 1986. Any authorized & recent publication on Government Acts.
9. Industrial Pollution Control and Environmental Audit by Sanjay Gupta

PEC	EARTHQUAKE RESISTANT DESIGN SYSTEMS	DE-CE 810	3 1 0	4 CREDITS
COURSE OUTCOMES:				
CO1	Understand the basic concepts on theory of Engineering Seismology.			

CO2	Analyze of Single & Multi degree of freedom.
CO3	To Acquire knowledge in knowing the performance of buildings under past earthquakes.
CO4	Understand the underground water Sources.
CO5	To get knowledge on earthquakes and its resistant features for different types of buildings.

Unit I

Engineering Seismology: Introduction to seismic hazard, Earthquake phenomenon, Seismotactonics and seismic zoning of India, Earthquake monitoring and seismic instrumentation, characteristics of strong earthquake motion, effect of structural irregularities on the performance of buildings during earthquake and seismoresistant building architecture

Unit II

Dynamics of structures: Analysis of single degree of freedom and multi degree of freedom systems, concept of shear building.

Unit III

Evaluation of earth forces: Seismic analysis by IS: 1893- 2000 (Part- I)

Unit IV

Earthquake resistant design of buildings: Ductility considerations, earthquake resistant design of RC buildings, design of infill walls, design of shear wall.

Unit V

Earthquake resistant earthen and masonry buildings: design consideration, guidelines.

References :

1. Pankaj Agarwal and Manish Shrikhande –Earthquake Resistant Design of Structures‖, Prentice Hall of India.
2. S.K. Duggal –Earthquake Resistant Design of Structures‖, Oxford University Press.
3. M. Paz –Structural Dynamics- Theory and Computation‖ CBR Publishers.
4. A.K. Chopra, –Dynamics of Structures: Theory & Application of Earthquake engineering‖, Pearson.
5. IS: 1893 (Part- I)
6. IS: 4326
7. IS: 13920
8. IIT K- BMTPC Earthquake Tips

OPEN ELECTIVE – I

OEC	ENVIRONMENTAL POLLUTION & MANAGEMENT	OE-CE 501	3 0 0	3 CREDITS
COURSE OUTCOMES:				
CO1	Identify the impact of human on environment.			
CO2	Identify the water & thermal pollution sources. Apply the prevention of its causes.			
CO3	Identify the noise, land & air pollution sources. Apply the prevention of its causes.			
CO4	Apply the EIA			
CO5	Identify the contemporary issues.			

Unit 1

Impact of man on environment, consequence of population growth, energy problem, pollution of air, water and land, Global environmental issues.

Unit II

Water pollution: Sources and classification of water pollutants, wastewater treatment, control strategies, Eutrophication of lakes, self purification capacity of streams. Waste load allocation.
Thermal pollution: Sources, effects and control measures.

Unit III

Air pollution: Sources and effects, meteorological aspects, control methods and equipments,
Land pollution: Types of land pollution, solid waste management-generation, storage, collection, transport, processing and disposal.
Noise pollution: Sources, effects, preventive and control measures.

Unit IV

EIA: Planning and management of environmentalimpact studies; Impact evaluation methodologies:baselinestudies, screening, scooping, checklist, overlays, Environmental impact assessment of water resources and environmental projects, Case study of power plant.
EA: Meaning, audit items, audit procedure, safety audit.

Unit V

Contemporary issues: Emission trading, discharge permits, international resource sharing issues, climate change, international environmental treaties and protocol.
Environmental legislation: Introduction to various legislations related to water, air, biodiversity, ozone depletion etc at National and International level; Institutions for governance.

References :

1. Principles of environmental studies (Ecology, economics, management and law) by C. Manoharachary and P. Jayarama Reddy, B.S. Publications.
2. Text of Environmental Engineering by P.V. Rao, Prentice Hall pvt ltd., Delhi
3. Environmental impact assessment methodologies by Y. Ananayulu and C.A. Sastry, B.S. Publications, Hyderabad

OEC	URBAN & TOWN PLANNING	OE-CE 502	3 0 0	3 CREDITS

COURSE OUTCOMES:

CO1	Understanding the urban areas.
CO2	Apply the Urban planning.
CO3	Apply the town & country planning.
CO4	Understand the traffic transportation systems.
CO5	Understanding the Development plans.

UNIT-I

Definition and classification of urban areas - Trend of urbanization - Planning process - Various stages of the planning process - Surveys in planning. Plans - Delineation of planning areas. utility of spaces, future growth etc. Role of "Urban Planner "in planning and designing in relation with spatial organization, utility, demand of the area and supply

UNIT-II

Plan implementation- Urban Planning agencies and their functions - Financing- Public, private, Nongovernmental organizations- Public participation in Planning. Development control regulations. sustainability and rationality in planning, Components of sustainable urban and regional development, Emerging Concepts: Global City, inclusive city, Safe city, etc. City of the future, future of the city.

UNIT-III

Town and country planning act- Building bye-laws. Elements of City Planning, Zoning and land use, Housing. Introduction to landscaping, importance , objectives, principles, elements, Urban Planning standards Urban renewal for quality of life and livability.

UNIT-IV

Traffic transportation systems: urban road, hierarchy, traffic management, Intelligent Transport Systems. Legal Issues in Planning and Professional Practice, Concepts and contents related to planning provision regarding property rights, Concept of Arbitration, State and Central government to deal with various matters concerning Town and Country Planning. mechanism for preparation of DP: Land Acquisition Rehabilitation and Resettlement Act 2013.

UNIT-V

Types of Development plans: Master Plan, City Development Plan, Structure Plan ,housing, land use, Water Supply & sanitation, etc., Planning agencies for various levels of planning. Their organization and purpose (CIDCO-MHADA-MIDC, MMRDA/ PMRDA etc).

Reference Books:-

1.Adib Kanafani.(1983). Transportation Demand Analysis. Mc Graw Hill Series in Transportation, Berkeley.

2. Hutchinson, B.G. (1974). Principles of Urban Transport Systems Planning. Mc Graw Hill

OE-EC 501 Laser Systems and its Application

L-T-P-C
3-0-0-3

OEC	Laser Systems and its Application	OE-CE 501	3 0 0	3 CREDITS
COURSE OUTCOMES:				
CO1	**Understand quantum physics needed for describing Laser operation**			
CO2	**Describe Einstein's Coefficients and population inversion condition**			
CO3	**Describe Components of Laser and explain its operating principles**			
CO4	**Analyze Laser in different physical states**			
CO5	**Appreciate numerous applications of Laser in Medical and Engineering field**			

Unit-1 (7 Hrs)
Introduction: Review of elementary quantum physics, Schrodinger equation, concept of coherence, absorption, spontaneous emission and stimulated emission processes,
Unit-2 (7 Hrs)
Equation: Relation between Einstein's A and B coefficients, population inversion, pumping, gain, optical cavities.

Unit-3 (8 Hrs)
Lasers: Main components of Laser, principle of Laser action, introduction to general lasers and their types. Three & four level Lasers, CW & Pulsed Lasers.

Unit-4 (6 Hrs)
Laser Systems: Atomic, ionic, molecular, excimer, liquid and solid state Lasers and systems, short pulse generation and Measurement.

Unit-5 (8 Hrs)

Applications: Laser applications in medicine and surgery, materials processing, optical communication, metrology and LIDAR and holography.

Text/ Reference Books:

1. K.R. Nambiar, "Laser Principles, Types and Application" New Age International.
2. S. A. Ahmad, "Laser concepts and Applications" New Age International.

OE-EC 502 Bio-Medical Engineering

L-T-P-C
3-0-0-3

Course Outcomes: At the end of semester, student will be able to:

1. Relate biological world to electronics circuit and gain knowledge about implementation of different sensors in the circuits targeted for various medical devices used for curing of human and other living beings.
2. Related biological signal with electrical concepts and implement the knowledge in development of cardio vascular respectively and nervous system related bio electronics instruments.
3. Gain basic knowledge regarding requirements of ICU, CCU and OR.
4. Gain basic understanding about medical imaging equipment Like CT scan, MRI, PET etc. and will improve the existing designs also.

Unit-1 (10 Hrs)

Electrodes, Sensors and Transducers: Signal Acquisition, Transduction, Active v/s Passive sensors, Sensor error sources, sensor terminology, signal processing, electrodes for biophysical sensing, medical surface electrodes, microelectrodes, different types of transducers.

Electrocardiography: Generation of electric currents in heart, ECG waveform, standard lead system, ECG preamplifier, ECG readout devices, ECG machines, ECG machine maintenance, faults and troubleshooting.

Unit-2 (8 Hrs)

Cardio vascular measurements and Devices: Physiological pressure measurements, B.P. measurements, Oscillometric and Ultrasonic non-invasive pressure measurements, pressure transducers, pressure amplifiers, calibrations methods, detector circuits, dilution methods, blood flow measurements. Introduction to plethysmography, phonocardiograph, defibrillators, pacemakers, heart lung machine.

Unit-3 (7 Hrs)

Respiratory system measurements and Devices: Human respiratory system, gas laws, internal respiration, external respiration, mechanics of breathing, parameters and regulations of respiration, respiratory transducers, medical gases, introduction to spirometer and artificial ventilators.

Unit-4 (10 Hrs)

Nervous system measurements and Devices: Organization of Human nervous system, cerebral angiography, cranial X-rays, brain scans, system preamplifier and specifications of EEG, EEG electrodes, EEG telemetry system, typical EEG system artifacts, faults, trouble shooting and maintenance.

ICUs, CCUs and Operating Rooms (Ors): ICU/CCU equipments, Bedside monitors, central monitoring consoles, ECG and physiological telemetry, types of surgery, OR personal, sterilization, OR equipments.

Unit-5 (11 Hrs)

Medical Laboratory Instrumentation: Blood tests, Colorimeter, flame photometer, spectrophotometer, blood cell counters, pH and blood gas analyzers, auto analyzer, dialysis machine, Electrical safety precautions, typical faults.

Medical Imaging Equipments: Basic Principles and working of various medical imaging modality: X-ray, CT Scan, MRI, PET Scan, Ultrasonography, color Doppler, Echocardiography, nuclear medical imaging.

Text/Reference Books:

1. R.S.Khandpur, Handbook of Biomedical Instrumentation, Tata McGraw Hill, New Delhi, 2003, Edition-II.
2. Cromwell L, Weibell FJ, Pfeifer EA, Biomedical Instrumentation and Measurements, 2nd Edition, PHI
3. G.S. Sawhney, Fundamentals of Biomedical Engineering, New Age Publications
4. J. J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technology",4th Edition, Prentice Hall, 2000.
5. Bruce, "Biomedical Signal Processing & Signal Modeling," Wiley, 2001.
6. Chatterjee, Biomedical Instrumentation Systems, Cengage learning 2011.

Industrial Engineering and Automation (OE-ME-501)

L T P C
3 0 0 3

Prerequisite: Basic Knowledge of Workshop Practice.

Course Outcomes (COs):

After completing this course a student will be able to:

1. Analyze and explain productivity concepts and measurements.
2. Explain various Industrial Layout and time study.
3. Exhibit skills towards program evaluation and review technique.
4. Analyze and perform Break even analysis.
5. Understand of High Volume Production Systems, Transfer Devices and Feeder.

Course Contents:

Unit I

Introduction: Engineering economy and costing, cost analysis, methods of depreciation, productivity concepts and measurements, job evaluation, methods of job evaluation, merit rating, wage incentive plan, types of wage incentive plans.

Unit II

Work measurement, time study,predetermined motion and time study(PMTS), work sampling, method study, micro motion study, principles of motion economy.

Unit III

Plant location, Types of Layout, Principles of Facility Layout, Objective Functions, Steps in PPC, Planning, Routing, Scheduling, Loading, Dispatching, Effectiveness of PPC.

Unit IV

PERT, CPM, Resource Allocation and GERT- Program Evaluation and Review Technique (PERT), Critical Path Method (CPM), Scheduling with Resource Constraints. Introduction to quality management, Ergonomics.

Unit V

High Volume Production Systems- Transfer Devices, Feeder classification, Construction and Applications, Automated Flow lines, Analysis of Automated Flow lines for Reliability and Efficiency, Assembly Systems, Robot Technology, Flexible Manufacturing Systems (FMS).

Textbooks:

1. Industrial Engineering by M.S. Mahajan, DhanpatRai and Co. (P) Ltd.
2. Introduction to Robotics by S.K. Saha, Tata Magraw Hill

Reference Books:

1. Introduction to Industrial System Engineering by Turner w.c. et Al 1993,Prentice Hall
2. Motion and Time Study, Design and Measurement of Work by Ralph M. Barnes, Wiley Publishers**.**
3. Project Management for Business and Technology by John M Nicholas, PHI
4. Robotics by John M Nicholas, Pearson Education.

Total Quality Management (OE-ME-502)

L T P C
3 0 0 3

Prerequisite: Basic Knowledge of Industrial Engineering

Course Outcomes (COs):

After completing this course a student will be able to:

1. Describe the dimensional barrier regarding Quality.
2. Summarize the Total quality principles.
3. Demonstrate the tools utilization for quality improvement. Analyze the various types of techniques are used to measure quality
4. Discover the new decision of principle in real time projects.
5. Apply the various quality systems in implementation of Total quality management.

Course Contents:

Unit I

Quality Concepts: Evolution of Quality control, concept change, TQM Modern concept, Quality concept in design.Control on Purchased Product: Procurement of various products, evaluation of supplies, capacity verification, Development of sources, procurement procedure.

Manufacturing Quality: Methods and Techniques for manufacture, Inspection and control of product, Quality in sales and services, Guarantee, analysis of claims.

Unit II

Quality Management: Organization structure and design, Quality function, DE-CEntralization, Designing and fitting organization for different types products and company, Economics of quality value and contribution, Quality cost, optimizing quality cost, seduction programme.

TQM Principles: Leadership, strategic quality planning; Quality councils- employee involvement, motivation;Empowerment; Team and Teamwork; Quality circles, recognition and reward, performance appraisal; Continuous process improvement; PDCE cycle, 5S, Kaizen; Supplier partnership, Partnering, Supplier rating & selection.

Unit III

Tools and Techniques: Seven QC tools (Histogram, Check sheet, Ishikawa diagram, Pareto, Scatter diagram, Control chart, flow chart).

Control Charts: Theory of control charts, measurement range, construction and analysis of R charts, process capability study, use of control charts, P-charts and C-charts.

Unit IV

Defects Diagnosis and Prevention: Defect study, identification and analysis of defects, corrective measure, factors affecting reliability, MTTF, calculation of reliability, Building reliability in the product, evaluation of reliability, interpretation of test results, reliability control, maintainability, zero defects, quality circle.

Unit V

IS0 and its concept of Quality Management: Quality systems, need for ISO 9000, ISO 9001-9008; Quality system- elements,documentation, Quality auditing, QS 9000, ISO 14000- concepts, requirements and benefits; TQM implementation in manufacturing and service sectors, Auditing, Taguchi method, JIT in some details.

Textbooks:

1. Total Quality Management by Mukherjee, P.N.
2. Janakiraman B. and Gopal R.K., Total Quality Management, Prentice Hall India, 2006.
3. Total Quality Management, by Dale H. Bester field, Pearson India.

Reference books:

1. Beyond Total Quality Management, Greg Bounds, McGraw Hill.
2. Bester field D.H. et al., Total quality Management, 3rd ed., Pearson Education Asia, 2006.
3. Evans J.R. and Lindsay W.M., The management and Control of Quality, 8th ed., first Indian edition, Cengage Learning, 2012.
4. Suganthi L. and Samuel A., Total Quality Management, Prentice Hall India, 2006.
5. TQM in New Product manufacturing, H. G. Menon, McGraw Hill.

Production Planning and Control (OE-ME-503)

L T P C

3 0 0 3

Prerequisite:

Course Outcomes (COs):

After completion of this course student will be able to:

1. Understand the role Production Planning and control activities in Manufacturing and Services.
2. Understand and perform various Forecasting techniques and problems.
3. Understand and perform various Inventory Management techniques and apply in real manufacturing scenario/How to use MRP/ERP.
4. Demonstrate various Scheduling procedures/Balancing concepts.
5. Understand and Evaluate Dispatching procedures.

Course Contents:

UNIT I

Introduction: Definitions – objectives of production planning and control functions of production planning and control-elements of production control types of production- organization of production planning and control – internal organizations department.

UNIT II

Forecasting: Importance of forecasting – types of forecasting, their uses general principles of forecasting techniques- Qualitative methods and quantitative methods.

UNIT III

Inventory management: Functions inventory- Relevant inventory cost- ABC analysis- VED Analysis- EOQ model – Inventory control systems – P- Systems and Q – Systems Introduction to MRP and ERP, LOB (Line of balance), JIT inventory, Japanese concepts.

UNIT IV

Routing: Definition **–** routing procedure- Route sheets – Bill of material factors affecting routing procedure.Schedule – definition – difference with loading. Scheduling polices – techniques, standard scheduling methods- job shop, flow shop, Line balancing, aggregate planning- methods for aggregate planning- Chase planning, expediting, control aspects.

UNIT V

Dispatching: Activities of dispatcher- Dispatching procedure - follow up – definition – reasons for existence of functions – types of follow up, applications of computer in production planning and control

Textbooks:

1. K C Jain and L N Agarwal, Production Planning and Control, 6th edition, Khanna Publishers, 2008.
2. M Mahajan, Production Planning and Control, Dhanpat Rai & Co., 2010.

Reference Books:

1. R Paneerselvam, Production & Operations Management, 2nd edition, PHI Publications, 2006.
2. E S Baffa and R K Sarin, Modern Production & Operation Managements, 8th edition, Wiley Publications, 2009.
3. O P Khanna, Industrial Engineering and Management, Dhanpat Rai & Co., 2009.
4. Samuel Eilon, Elements of Production Planning and Control, The Macmillan Company, New York.
5. S D Sharma, Operations Research, KedarnathRamnath Publishers, 1996.
6. J K Sharma, Operations Research, 4th edition, Macmillan India Limited, 2009.
7. P Ramamurthy, Production and Operations Management, New Age International Publications, 2007
8. K L Narayana, P Kannaiah and K Venkata Reddy, Machine Drawing, 3rd edition, New Age Publications, 2006.

Value Engineering (OE-ME-504)

L T P C

3 0 0 3

Prerequisite:

Course Outcomes (COs):

After completing this course a student will be able to:

1. Understand concepts of value engineering and value analysis.
2. Understand the evaluation techniques of function and problem setting and solving systems.
3. Describe various phases involved in value engineering job plan and techniques of value engineering.
4. Understand the applications of value Analysis of management practice in different organizations.
5. Demonstrate their ability to apply value analysis in various fields.

Course Contents:

UNIT I

Introduction to value analysis: Definition of Value, Value Analysis, Value Engineering, Value management, Value Analysis versus Value Engineering, Value Analysis versus Traditional cost reduction techniques, uses, applications, advantages and limitations of Value analysis. Symptoms to apply value analysis, Coaching of Champion concept.

Type of values: Reasons for unnecessary cost of product, peeling cost Onion concept, unsuspected areas responsible for higher cost, Value Analysis Zone, attractive features of value analysis. Meaning of Value, types of value & their effect in cost reduction. Value analysis procedure by simulation.Detailed case studies of simple products.

UNIT II

Functional cost and its evaluation: Meaning of Function and Functional cost, Rules for functional definition, Types of functions, primary and secondary functions using verb and noun, Function evaluation process, Methods of function evaluation. Evaluation of function by comparison, Evaluation of Interacting functions, Evaluation of function from available data, matrix technique, MISS technique, Numerical evaluation of functional relationships and case studies.

Problem setting & solving system: A problem solvable stated is half solved, Steps in problem setting system, Identification, Separation and Grouping of functions. Case studies.

Goods system contains everything the task requires. Various steps in problem solving, case studies.

UNIT III

Value engineering job plan: Meaning and Importance of Value Engineering Job plan. Phases of job plan proposed by different value engineering experts, Information phase, Analysis phase, Creative phase, Judgments phase, Development planning phase, and case studies. Cost reduction programs, criteria for cost reduction program, Value analysis change proposal.

Value engineering techniques: Result Accelerators or New Value Engineering Techniques, Listing, Role of techniques in Value Engineering, Details with Case examples for each of the techniques.

UNIT IV

Advanced value analysis techniques: Functional analysis system technique and case studies, Value Analysis of Management Practice (VAMP), steps involved in VAMP, application of VAMP to Government, University, College, Hospitals, School Problems etc., (service type problems).

Unit V

Total value engineering: Concepts, need, methodology and benefits.

Application of value analysis: Application of Value analysis in the field of Accounting, Appearance Design, Cost reduction, Engineering, manufacturing, Management, Purchasing, Quality Control, Sales, marketing, Material Management Etc., Comparison of approach of Value analysis & other management techniques.

Textbooks:

1. Techniques of Value Analysis and Engineering – Lawrence D. Miles - McGraw Hill Book Company - 2nd Edition.
2. Value engineering for Cost Reduction and Product Improvement – M.S. Vittal – Systems Consultancy Services – Edn.1993.
3. Value Management, Value Engineering and Cost Reduction – Edward D Heller – Addison Wesley Publishing Company-1971.

Reference books:

1. Value Analysis for Better Management – Warren J Ridge – American Management Association - Edition1969.
2. Getting More at Less Cost (The Value Engineering Way) – G. Jagannathan - Tata McGraw Hill Pub. Comp Edition1995.
3. Value Engineering – Arther E Mudge - McGraw Hill Book Comp.-Edn1981.

Operation research (OE-CS 501)

COURS OUTCOME:

After completion of the course students will be able to:

1. Express objective function and resource constraints in LP model in terms of decision variables and parameters.

2. Construct the initial transportation table for a trans-shipment problem and to solve a profit maximization transportation problem using suitable changes in the transportation algorithm.

3.Appreciate application of integer LP problem in several areas of managerial decision- making and to use linear programming approach to compute the value of the game when dominance rule do not apply.

4. Derive replacement policy for items whose running cost increases with time and to use various selective inventory control techniques to classify inventory items into broad categories.

5.Derive relationship among variety of performance measures using Probability Distributions and Dynamic Programming are used for Optimization.

DETAIL SYLLABUS

UNIT-1 Introduction To Linear Programming : Definition and scope of operations research (OR), OR model, Problem Formulation and Application of LPP model, Graphical LPP solution, Simplex method, Big M-method, Two phase method, Special cases in Simplex method application, Duality in Linear Programming, Dual Simplex method, Sensitivity analysis, various industrial application of Linear Programming

UNIT-2 Linear Programming Extension -Transportation Models: Formulation and Optimal solution of Transportation problem, Method of finding Initial Solution – **NWCM,, LCM, VAM**, Close loop in Transportation Table and its properties, Variation in Transportation problem – Degeneracy and its resolution, Trans Shipment models, Assignment models - Hungarian method for solving Assignment Problem, Travelling Salesman problem.

UNIT-3 Integer Programming ,Game Theory ,Sequencing and Project Management:

Integer Programming -Formulation and solution of Integer linear programming problems, Enumeration and cutting plane solution concept, Branch and Bound algorithm. **Game Theory** : Introduction, Two person Zero Sum Game, Minimax and, Maximin Principles Rules of Dominance. **Sequencing problems**-Travelling Salesman problem, Machine-scheduling problem (Job shop). **Project Management**-Objectives of **CPM** and **PERT,** Characteristic of **CPM/PERT** projects..

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UNIT-4 Replacement and Inventory models:

Replacement Problems- Optimal age of equipment replacement, Replacement of items that fail, Individual and group replacement policies.

Inventory models- Deterministic Inventory models, Classic **EOQ** model, **EOQ** with price breaks, single item Inventory control models without/with shortage, multi-item Inventory control models with constraints, single item Inventory control models with quantity discounts.

UNIT-5 Queuing Theory and Dynamic Programming:

Queuing Theory – Structure of a Queuing system, Probability Distribution in Queuing System, classification of Queuing models - Single server Queuing models/Multi server Queuing models.
Dynamic Programming- Dynamic Programming formulations, Bellman's principle of optimality, computation in Dynamic Programming, Forward and Backward recursions.

References:

Text / Reference Books:

1. Wayne L. Winston, "Operations Research" Thomson Learning,2003.
2. Hamdy H. Taha, "Operations Research-An Introduction" Pearson Education,2003.
3. R. Panneer Seevam, "Operations Research" PHI Learning, 2008.
4. V. K .Khanna, "Total Quality Management" New Age International, 2008.
5. Rao S.S. " Optimization Theory and Applications ", Willey Eastern Limited.
6. Taha H.A., " Operation Research-An Introduction ", Macmillan.
7. J .K. Sharma," Applied Operations Research", Trinity

Graph Theory (OE-CS 502)

Course outcomes:

After the course the student will have a strong background of the graph theory which has diverse applications in the area of computer science, biology, chemistry, physics & engineering.

DETAIL SYLLABUS

UNIT 1. Graphs: Graphs, Sub graphs, some basic properties, various example of graphs & their sub graphs, walks, trails, path & circuits, connected graphs, disconnected graphs and its components, various operation on graphs, unicursal line, Euler graphs, Hamiltonian paths and circuits, Hamiltonian graph, traveling salesman problem, Chinese Postman problem. Fleury's algorithm for constructing an Euler line in a graph G, directed graphs, types of directed graphs, directed paths and connectedness, circuits in digraph, Hamiltonian and Euler digraphs.

UNIT 2. Trees: Trees and its characterization, distance, eccentricity and centre, diameters, radius of a tree and pendent vertices, rooted and binary trees, spanning trees, height of a binary tree, traversing binary tree, depth-first search and breath first search in a graph. Branches and chord, rank and nulity, on counting trees, trees with directed edges, fundamental circuits, finding all spanning trees of a graph and a weighted spanning tree, minimum weight spanning tree algorithm, , Prim's, Kruskal's and Dijkstra's algorithm.

UNIT 3. Cut sets & Network flow, Planar Graphs: Cuts sets and cut vertices, some properties, all cut sets in a graph, fundamental circuits and cut sets, connectivity in a graph and separable graph.

Transportation Networks: Networks flows, Max-flow-min cut theorem.
Planar Graphs: planar graphs, region and its degree, Euler's formula, Kuratowski's theorem and its application to planarity detection of graphs,dual graphs, combinational and geometrical dual, thickness and crossings.
UNIT 4. Matrix Representation and Colouring of Graphs: Incidence matrix of graph, sub matrices of A(G), circuit matrix, cut set matrix, fundamen tal circuit matrix and rank of matrix B, path matrix ,adjacency matrices, adjacency matrix of a digraph and their properties . **Colouring Of Graphs** : Colouring, , chromatic number, colour critical graph, chromatic partitioning, chromatic polynomials, matching, maximal matching, augmenting path, covering, minimal covering , Four colour problems, five colour theorem.
UNIT 5. Enumeration of graphs: Enumeration: types of enumeration, counting of labelled and unlabelled graphs and trees, cycle index of permutation group, Cayley's theorem, statement of Burnside's theorem, figure counting series and configuration series, Polya's Enumeration(or counting)theorem, Application of Polya's theorem in Graph Enumeration.

REFERENCE

1. Deo N., Graph Theory with Applications to Engineering and Computer Science, Prentice-Hall, Inc.
2. Bondy and Murthy: Graph theory and application. Addison Wesley.
3. John M. Aldous and Robin J. Wilson: Graphs and Applications-An Introductory Approach, Springer
4. Robin J, Wilson: Introduction to Graph Theory, Addison Wesley
5.Kalika Patraj: Graph theory, S.K. Kataria & Son's, N .Delhi.

Computer based numerical and statistical techniques (OE-CS 503)

Course Outcomes:

1. Gain insight about design and analysis of standard searching and sorting algorithms. Learn various algorithm Analysis techniques.
2. Able to compare between different data structures i.e., trees, heaps etc. also, pick an appropriate data structure for a design situation.
3. Learn divide and conquer, Greedy paradigms and understand and analyze when an algorithmic design situation calls for them.
4. Developing and analyzing the solutions for the problems using Dynamic programming, backtracking and Branch and bound approaches..
5. Understand NP completeness and difference between NP-Hard & NP-complete problems..

Detailed Contents:

Unit 1:

Introduction: Numbers and their accuracy,Mathematical preliminaries, Errors and their Computation, General error formula, Error in a series approximation.

Solution of Algebraic and Transcendental Equation:

Bisection method, Iteration method, Aitken's Δ^2 method, method of False position, Newton-Raphson method, methods of finding complex roots, Rate of convergence of Iterative methods.

Unit 2:

Sorting and Order Statistics: Heapsort, Priority queues, Quicksort, Merge sort, Sorting in linear time.

Advanced Design and Analysis Techniques: Dynamic programming – Elements, Matrix-chain multiplication, longest common subsequence, Travelling Salesperson problem, Greedy algorithms – Elements, activity-selection problem, Huffman codes, task scheduling problem, Knapsack Problem, Backtracking – Elements, 8 – Queens, Graph Coloring, Hamiltonian Cycles.

Unit 3:

Advanced Data Structures: Operations in B-Trees, Binomial heaps, Fibonacci heaps, data structures for disjoint sets, strings.

Unit 4:

Graph Algorithms: Review of graph algorithms, topological sort, strongly connected components, minimum spanning trees – Kruskal and Prim's, Single source shortest paths, relaxation, Dijkstra's algorithm, Bellman-Ford algorithm, single source shortest paths for directed acyclic graphs.

Unit 5:

P – Hard & NP – Complete problems: Basic concepts, Clique Decision problem, Node Cover decision problem, Travelling Salesperson decision problem, Introduction to approximation algorithms Planer Graph Coloring, Maximum programs stored problem.

Suggested reference books:

1. Cormen, Leiserson and Rivest: Introduction to Algorithms, 2/e, PHI.
2. Horowitz, Sahni, and Rajasekaran: Fundamentals of Computer Algorithms, Second Edition, Universities Press, Hyderabad.
3. Aho, Hopcroft, and Ullman: The Design and Analysis of Computer Algorithms, Addison Wesley.

OE-EE 501	VLSI Circuits	L-T-P-C: 3-0-0-3
Course Outcomes: At the end of this course students will demonstrate the ability to		
CO1	Comprehend IC Fabrication Techniques	
CO2	Analyse and design MOSFET logic circuits	
CO3	Analyse and design CMOS logic circuits	
CO4	Design Read Only Memory, Random Access Memory	
CO5	Design Adders, multipliers	

UNIT-I

Material Preparation- Purification, Crystal growth (CZ and FZ process), wafer preparation Thermal Oxidation- Growth mechanisms, Dry and Wet oxidation, Deal Grove model.

Diffusion- Fick's Laws, Diffusion with constant surface concentration and from a constant source, diffusion techniques.

Ion implantation-Technique, Range Theory, annealing

UNIT-II

Epitaxy: Vapour phase epitaxy and molecular beam epitaxy

Lithography- Photo lithographic sequence, Electron Beam Lithography, Etching and metal deposition

Methods of isolation, Circuit component fabrication: transistor, diodes, resistors, capacitors, N-well CMOS IC Fabrication Sequence

UNIT-III

CMOS inverters- DC characteristics, switching characteristics, power dissipation

Layout Design rules, Stick Diagram and layout of CMOS Inverter, two input NAND and NOR gates

MOSFET Logic Design -Pass transistor logic, Complementary pass transistor logic and transmission gate logic, realization of functions

UNIT-IV

Read Only Memory- 4x4 MOS ROM Cell Arrays (OR,NOR,NAND)

Random Access Memory – SRAM-Six transistor CMOS SRAM cell, DRAM –Three transistor and One transistor Dynamic Memory Cell

Sense amplifiers – Differential Voltage Sensing Amplifiers Introduction to PLDs and FPGAs, Design of PLAs

UNIT-V

Adders - Static adder, Carry-By pass adder, Linear Carry- Select adder, Square- root carry- select adder

Multipliers - Array multipliers

Text Books:

1. John P Uyemura, Introduction to VLSI Circuits and Systems, Wiley India, 2006

2. S.M. SZE, VLSI Technology, 2/e, Indian Edition, McGraw-Hill,2003

References:

1. Jan M.Rabaey, Digital Integrated Circuits- A Design Perspective, Prentice Hall, Second Edition, 2005.

2. Neil H.E. Weste, Kamran Eshraghian, Principles of CMOS VLSI Design- A Systems Perspective, Second Edition. Pearson Publication, 2005

3. Razavi - Design of Analog CMOS Integrated Circuits,1e, McGraw Hill Education India Education, New Delhi, 2003.

4. Sung –Mo Kang & Yusuf Leblebici, CMOS Digital Integrated Circuits- Analysis & Design, McGraw-Hill, Third Ed., 2003.

5. Yuan Taur&Ning, Fundamentals of Modern VLSI Devices, Cambridge University Press, 2008

OPEN ELECTIVE –II

OEC	WATER RESOURCES CONSERVATION	OE-CE 601	3 0 0	3 CREDITS
COURSE OUTCOMES:				
CO1	Explain water hydrology and environmental influence.			
CO2	Outline the concepts of Artificial Ground Water Recharge.			
CO3	Learn the Concept of Water Harvesting.			
CO4	Explain Reuse & Recycle of Waste Water and Watershed Management.			

UNIT-I

Ground and Surface Water Utilization- Historical background, Hydrologic Cycle, Water Budget, Ground Water level fluctuations and Environmental influence.

UNIT-II

Artificial Ground Water Recharge: Concept & methods of artificial ground water recharge, recharge mounds & induced recharge, wastewater recharge for reuse, Water Spreading, Farm Ponds and Percolation Tanks.

UNIT-III

Water Harvesting: Rainwater harvesting, Catchment Harvesting, Harvesting Structures, Soil Moisture Conservation, Check Dams.

UNIT-IV

Reuse & Recycle of Waste Water: Types of reuse, Application of treated waste water, Purity of reclaimed water, Guidelines and Regulations, New technologies used in recycling of Waste Water.

UNIT-V

Watershed management- Introduction, Concept of watershed Management, Watershed Management policies and decision making.

REFERENCES

1. Ramakrishnan S.(1996),"Ground water", Scitech Publications, 2nd Edition.
2. Todd D.K. & Mays L. F.(2006),"Groundwater Hydrology", John Wiley and sons, 2nd Edition.
3. Murthy J.V.S.(1998), “Watershed Management”, New Age International Publishers, 2nd Edition.
4. Murthy V.V.N.(2013), “ Land and Water Management”, Kalyani Publications, 6th Edition.
5. US Environment Protection Agency, 1992. “Guidelines for Water Reuse”.

0EC	ENVIRONMENTAL MANAGEMENT	OE-CE 602	3 0 0	3 CREDITS
COURSE OUTCOMES:				
CO1	Identify the various environmental issues.			
CO2	Apply Environmental impact assessment.			
CO3	Apply the Environmental policies & technology for environment management.			
CO4	Identify the Contemporary issues.			
CO5	Apply the Environmental legislation.			

Unit I

Introduction: Need for environmental awareness, protection of natural and manmade systems, Impact of man on environment.

Emerging global environmental issues: Population growth, climate change and global warming effects, aid rain, ozone layer depletion, urbanization, automobile pollution

Unit II

EIA: Planning and management of environmental impact studies; Impact evaluation methodologies: base line studies, screening, scooping, checklist, overlays, Environmental impact assessment of water resources and environmental projects, Case study of power plant, Hydro power plant

EA: Meaning, audit items, audit procedure, safety audit.

Unit III

Sustainable development, Environmental economics, environmental policy in planned, mixed and market economies,

Emerging technologies for environmental management; Life cycle analysis- methodology, tools and problems, Concept of ISO and ISO 14000; Environmental cost benefit analysis, Decision methods for evaluation of alternatives, Environment risk assessment, Environmental valuation: Approaches to valuation.

Unit IV

Contemporary issues: Emission trading, discharge permits, international resource sharing issues, international environmental treaties and protocol.

Unit V

Environmental legislation: Introduction to various legislations related to water, air, biodiversity, ozone depletion etc at National and International level; Issues involved in the enforcement of environmental legislation, Initiatives by NGO‘s, Initiatives by Governments, CPCB, Other institutions of governance.

References :

- Principles of environmental studies (Ecology, economics, management and law) by C. Manoharachary and P. Jayarama Reddy, B.S. Publications.

- Environmental Impact Assessment Methodologies by Y. Ananayulu and C.A. Sastry, B.S.

OE-EC 601 Robotics

L-T-P-C
4-0-0-4

Course Outcomes: After the completion of this course, the students will be able to:

1- Understand the basics of robotic systems and different types of robots.
2- Perform kinematic and dynamic analyses with simulation.
3- Know about different types of sensors and robotic eye: geometry of image formation.
4- Know different types of actuators and grippers in robotics.
5- Select a robotic system for given industrial application.

Unit-1 (8 Hrs)

Introduction to Robotics: Types and components of a robot, Classification of robots,Different types of joints are used in robots, Kinematics systems, Definition of mechanisms and manipulators, Degrees of Freedom.

Unit-2

Robot Kinematics: Kinematic Modelling: Translation and Rotation Representation, Coordinate transformation, DH parameters, Forward and inverse kinematics, Jacobian, Singularity,

Dynamic Modelling: Forward and inverse dynamics, Equations of motion using Euler-Lagrange formulation, Newton Euler formulation.

Unit-3

Sensor: Contact and Proximity, Position, Velocity, Force, Tactile etc., Introduction to Cameras, Camera calibration, Geometry of Image formation, Vision applications in robotics.

Unit-4

Robot Actuation and gripper Systems: Types of Actuators: Electric, Hydraulic and Pneumatic. **Transmission:** Gears, Timing Belts and Bearings, Parameters for selection of actuators, grippers.

Unit-5

Robot Control: Basics of control: open loop- closed loop, Transfer functions, Control laws: P, PD, PID, Linear and Non-linear controls, Application of robotics systems: defence, medical, industries, etc., Robotics and Automation for Industry 4.0, Robot safety and social robotics.

Text/Reference Books:

1- Introduction to Robotics : J. Craig , Pearson
2- Robot Dynamics and Control, Spong & Vidyasagar, Mc Graw Hill
3- Robotics Engineering : R. Klafter, PHI - Robotics : Subir K Saha , Mc GrawHill
4- Industrial Robotics : M. P. Groover, Ashish Dutta , McGraw Hill

OE-EC 602 Mechatronics

L-T-P-C
4-0-0-4

Course Outcomes: After the successful completion of the course the students will be able to:

1. Identification of key elements of mechatronics system..
2. Understanding the concept of signal processing and use of interfacing systems such as ADC, DAC, digital I/O.
3. analyze the Interfacing of Sensors, Actuators using appropriate DAQ micro-controller
4. Understanding the concept of Time and Frequency domain analysis of system model (for control application)
5. Understanding the concept of PID control implementation on real time systems

Unit-1

Introduction: Introduction, scope and applications of Mechatronics systems. Process control automation, FMS and CNC Machines. MEMS: Basics of Micro- and Nanotechnology, microprocessor-based controllers and Microelectronics.

Unit-2

Introduction to Sensors: Linear and Rotational Sensors, Acceleration, Force, Torque, Power, Flow and Temperature Sensors, Light Detection, Image, and Vision Systems, Integrated Micro-sensors,

Introduction to Actuators: Electro-mechanical Actuators, Electrical Machines, Piezoelectric Actuators, Hydraulic and Pneumatic Actuation Systems, MEMS: Micro-transducers Analysis, Design and Fabrication.

Unit-3

Electronics elements in mechatronics, conductors, insulators and semiconductors, passive electrical components, resistors, capacitor and inductor, transformer, active elements, semiconductor devices, transistors and integrated circuits, digital electronics components like logic gates, flip-flops, shift register, multiplexer and counter. Computing elements in mechatronics, analog computer, timer, analog to digital converter, digital to analog converter,

Unit-4

System modeling and analysis, control system concepts, transfer function of physical systems, block diagrams representation of systems, transfer function of a system, standard input signals, time response of a first to a step input, frequency response analysis, automatic control systems,

Unit-5

Design of Mechatronics systems: Introduction of mechatronics systems: Home appliances, ABS (anti-lock braking system) and other areas in automotive engineering, Elevators and escalators

Data Acquisition and related Instrumentation: Introduction to Data Acquisition Measurement Techniques: Sensors and Transducers, Quantizing theory, Analog to Digital Conversion, Digital to

Analog (D/A) conversation, Signal Conditioning. Real time Instrumentation: Computer-Based Instrumentation Systems, Data Recording and Logging.

Text/Reference books:

1. Bolton, W., "Mechatronics: Electronic Control Systems in Mechanical and 2011 Electrical Engineering
2. Ramachandran K. P., Vijayaraghavan G. K., Balasundaram M.S. "Mechatronics: Integrated Mechanical Electronic Systems", Wiley
3. A Kuttan, "Introduction to Mechatronics, Oxford University Press, 2010.
4. Mechatronics HMT Hand Book, Tata McGraw Hill.
5. Alciatore and Histand, "Introduction to Mechatronics an Measurement Systems", Tata McGraw Hill.
6. Smaili and Mrad, "Mechatronics: Integrated Technologies for Intelligent Machines" Oxford
7. Mahalik N.P., "Mechatronics: Principles, Concepts and applications", Tata McGraw Hill.

Composite Materials (OE-ME 601)

L T P C

3 0 0 3

Prerequisite: Basic Knowledge of Materials Science.

Course Outcomes (COs):

1. Knowledge of the different types of engineering materials.
2. Knowledge of the types of reinforcements and fibers.
3. Understand the various types of composites used in engineering and their properties.
4. Describe the processing of composite materials and manufacturing techniques.
5. Understand and analyze the various methods of testing the composites.

Course Contents:

UNIT I

Introduction: Classifications of Engineering Materials, Concept of composite materials, Matrix materials, Functions ofa Matrix, Desired Properties of a Matrix, Polymer Matrix (Thermoset sand Thermoplastics), Metalmatrix, Ceramic matrix, Carbon Matrix, Glass Matrix etc.

UNIT II

Types of Reinforcements/Fibers: Role and Selection of reinforcement materials, Types of fibers, Glass fibers, Carbon fibers, Aramid fibers, Metal fibers, Alumina fibers, Boron Fibers, Silicon carbide fibers, Quartz and Silica fibers, Multiphase fibers, Whiskers, Flakes etc. Mechanical properties of fibres. Material properties that can be Improved by forming a composite material and its engineering potential.

UNIT III

Various types of composites: Classification based on Matrix Material: Organic Matrix composites, Polymer matrix composites (PMC),Carbon matrix Composites or Carbon-Carbon Composites, Metal matrix composites (MMC), Ceramicmatrix composites (CMC);Classification based on reinforcements: Fiber Reinforced Composites, FiberReinforced Polymer(FRP) Composites, Laminar Composites, Particulate Composites.

UNIT IV

Fabrication methods: Processing of Composite Materials: Overall considerations, Auto clavecuring, Other ManufacturingProcesses like filament welding, compression moulding, resin transplant method, pultrusion, pre-peglayer, Fiber-only performs, Combined Fiber-Matrix performs, Manufacturing Techniques: Tooling andSpecialty materials, Release agents, Peelplies, release films and fabrics, Bleeder

and breather plies, bagging films, maximum stress and strain criteria, Von Mises Yield criterion for isotropic materials.

UNIT V

Testing of Composites and Analysis: Mechanical testing of composites, tensile testing, Compressive testing, Intra-laminar shear testing, Inter-laminar shear testing, Fracture testing etc.Analysis of laminated plates- equilibrium equations of motion, energy formulation, static bending analysis, buckling analysis, free vibrations, natural frequencies.

Text Books:

1. Mechanical Metallurgy, by G. Dieter, McGraw Hill.
2. Engineering Materials: Polymers, Ceramics and Composites, by A.K Bhargava Prentice Hall India.
3. Analysis and Performance of Fiber Composites, by Agarwal, McGraw Hill.

Reference Books:

1. Materials characterization, Vol. 10, ASM hand book.
2. Thermal Analysis of Materials, by R.F. Speyer, Marcel Decker.
3. Engineering Mechanics and Composite Materials, by Daniels, Oxford University Press.
4. Material Science and Engineering (SIE) with CD, by Smith, McGraw Hill.
5. Gibson R.F. Principles of Composite Material Mechanics, second edition, McGraw Hill, 1994.

Entrepreneurship (OE-ME 602)

L T P C
3 0 0 3

Prerequisite: Basic Knowledge of industrial management.

Course Outcomes (COs):

1. Understand entrepreneurship and its related theory and government policies
2. Understand various Business Enterprises and Ownership Structure
3. Prepare project report and able to understand project evaluation method.
4. Understand various strategies and policies in management and enterprises.
5. Understand Institutional support towards the development of entrepreneurship.

Course Contents:

Unit I

Entrepreneurship: Definition, requirements to be an entrepreneur, entrepreneur and intrapreneur, entrepreneur and manager, growth of entrepreneurship in India, women entrepreneurship, rural and urban entrepreneurship.

Entrepreneurial Motivation: motivating factors, motivation theories-Maslow's Need Hierarchy Theory, McClelland's Acquired Need Theory, government's policy actions towards entrepreneurial motivation, entrepreneurship development programme.

Unit II

Business Enterprises and Ownership Structure Small scale, medium scale and large scale enterprises, role of small enterprises in economic development; proprietorship, partnership, companies and co-operatives firms: their formation, capital structure and source of finance.

Unit III

Project Management: Identification and selection of projects; project report: contents and formulation, concept of project evaluation, methods of project evaluation: internal rate of return method and net present value method.

Unit IV

Management of Enterprises: Strategy & policy, introduction to human resource management, marketing strategies, financial management & strategies: raising and managing capital, shares, debentures and bonds, cost of capital; break- even analysis.

Unit V

Institutional Support and Policies: Institutional support towards the development of entrepreneurship in India: Institutional framework, venture capitalist; technical consultancy organizations (TCOs), government policies for small scale enterprises.

Text Books:

1. Khanka, S S. 'Entrepreneurial Development', S Chand & Company Ltd. New Delhi.
2. Desai, Vasant, 'Project Management and Entrepreneurship', Himalayan Publishing House, Mumbai, 2002.
3. Gupta and Srinivasan, 'Entrepreneurial Development', S Chand & Sons, New Delhi.

Reference Books:

1. Ram Chandran, 'Entrepreneurial Development', Tata McGraw Hill, New Delhi
2. Saini, J. S. 'Entrepreneurial Development Programmes and Practices', Deep & Deep Publications (P), Ltd.
3. Holt, Davis, 'Entrepreneurship: New Venture Creations, PHI.

Mechanical System Design (OE-ME 603)

L T P C

3 0 0 3

Prerequisite: Basic Knowledge of Industrial Engineering.

Course Outcomes (COs):

After completing this course a student will be able to:

1. Understand the attributes characterizing a system and case study.
2. Explain the system modelling and case study compound bar system.
3. Differentiate and understand the graph modelling, graph analysis and materials handling systems.
4. Understand the method for optimization model with single system.
5. Justify the inventory control in production plant.

Course Contents:

UNIT I

Engineering process and System Approach Basic concepts of systems, Attributes characterizing a system, types of system, Application of system concepts, Advantages of system approach, Problems concerning systems, Concurrent engineering, A case study-Viscous lubrication system in wire drawing.

Problem Formulation: Nature of engineering problems, Need statement, hierarchical nature of systems, hierarchical nature of problem environment, problem scope and constraint, A case study: heating duct insulation system, high speed belt drive system.

UNIT II

System Theories: Introduction, System Analysis, Black box approach, state theory approach, component integration approach, Decision process approach, A case study- automobile instrumentation panel system. System modeling Introduction, Model types and purpose, linear systems, mathematical modeling, concepts, A case study compound bar system.

UNIT III

Graph Modeling and Analysis Graph Modeling and analysis process, path problem, Network flow problem, A case study: Material handling system.

Optimization Concepts Optimization processes, Selection of goals and objectives-criteria, methods of optimization, analytical, combinational, subjective. A case study: aluminum extrusion system.

UNIT IV

System Evaluation Feasibility assessment, planning horizon, time value of money, Financial analysis, A case study: Manufacture of maize starch system. 4 Calculus Method for Optimization Model with single decision variable, model with two decision variables, model with equality constraints, model with inequality constraints, A case study: Optimization of an insulation system.

UNIT V

Decision Analysis Elements of a decision problem, decision making, under certainty, uncertainty risk and conflict probability, density function, Expected monetary value, Utility value, Baye's theorem, A case study: Installation of machinery. 4 System Simulation Simulation concepts, simulation models, computer application in simulation, spread sheet simulation, Simulation process, problem definition, input model construction and solution, limitation of simulation approach, A case study: Inventory control in production plant.

Text Books:

1. Engineering Design, by Dieter, McGraw Hill.
2. Optimization Techniques-SS Rao.
3. Design Engineering-JR Dixon, TMH, New Delhi.
4. Engineering Design-Robert Matousck, Blackie and son ltd. Glasgow.

Reference Books:

1. An Introduction to Engineering Design Method-V Gupta and PN Murthy, TMH, New Delhi.
2. Design and Planning of Engineering systems-DD Reredith, KV Wong, RW Woodhead, and RR Worthman, Prentice Hall Inc., Eaglewood Cliffs, New Jerse.
3. System Analysis and Project Management-Devid I Cleland, William R King, McGraw Hill.

Product Design and Development (OE-ME 604)

L T P C

3 0 0 3

Prerequisite:

Course Outcomes (COs):

After completing this course a student will be able to:

1. Understand how to create new product based on mechanical design engineering.
2. Understand all mechanical aspects of product design by incorporating concept, creativity, structural, manufacturing, esthetic etc.
3. Solve open-ended problem belongs to design engineering that meet the requirements.
4. Understand various product designing methods.
5. Understand human factors and cost evaluation in industrial design concepts.

Course Contents:

Unit I

Design Fundamentals:

The importance of engineering design – types of design –the design process – relevance of product lifecycle issues in design –designing to codes and standards- societal considerations in engineering design –generic product development process – various phases of product development-planning for products – establishing markets- market segments- relevance of market research.

Unit II

Customer oriented design & Societal Considerations: Identification of customer needs- customer requirements- Quality Function Deployment Product Design Specifications- Human Factors in Design – Ergonomics and Aesthetics. Societal consideration - Contracts – Product liability – Protecting intellectual property – Legal and ethical domains – Codes of ethics - Ethical conflicts – Environment responsible design-future trends in interaction of engineering with society.

Unit III

Material selection processing and Design: Material Selection Process – Economics – Cost Vs Performance – Weighted property Index – Value Analysis – Role of Processing in Design – Classification of Manufacturing Process – Design for Manufacture – Design for Assembly –Designing for castings, Forging, Metal Forming, Machining and Welding – Residual Stresses – Fatigue, Fracture and Failure.

Unit IV

Design Methods: creativity and problem solving- creative thinking methods- generating design concepts - systematic methods for designing –functional decomposition – physical decomposition – functional representation – morphological methods-TRIZ- axiomatic design. Decision making theory- utility theory –decision trees –concept evaluation methods.

Unit V

Industrial Design concepts: Human factors design –user friendly design – design for serviceability – design for environment – prototyping and testing – cost evaluation –categories of cost –overhead costs – activity based costing – methods of developing cost estimates – manufacturing cost –value analysis in costing.

Text books:

1. Product Design & Manufacturing by A. K. Chitab& R. C. Gupta, PHI (EEE).
2. Product Design and Development by Karl T Ulrich, Steven D. Eppinger.
3. Product Design, by Kevin Otto, Kristin wood, Pearson Education Inc.

Reference books:

1. The Technology of Creation Thinking by R.P. Crew ford, Prentice Hall.
2. The Art of Thought by Grohem Walls, Bruce & Co., New York.
3. Product Design & Decision Theory by M.K. Starr, Prentice Hall.
4. Human Factor Engg. byMccormick E.J., McGrawHill.
5. Engineering: An Introduction to Creative profession by G.C. Beakley, H.W. Leach, Macmillan.
6. Industrial Design In Engineering – A marriage of Techniques by Charles H.Flurscheim, The Design Council - London.
7. Quality Control & Reliability Analysis by Bijendra Singh, Khanna Publications.

MODELING AND SIMULATION (OE-CS 601)

Course Outcomes:

Upon completion of the subject, students will be able to:

CO1: Understand the basics of simulation modeling and replicating the practical situations in organizations.

CO2: Realize Concepts in Discrete-Event Simulation and analyze and develop a number of simulation softwares.

CO3: understand and simulate various statistical and mathematical models

CO4: Generate random numbers and random variates using different techniques.

CO5: Analyze simulation data using input modelling as well as Understand Verification and Validation of simulation model.

Detail content

Unit 1: Introduction- advantages and disadvantages of simulation, application areas in communication, computer and software design, systems and systems environment, components of a system, discrete and continuous systems, model of a system, types of models, discrete-event simulation, steps in a simulation study. Simulation Examples- Simulation of queueing systems, on-demand and inventory systems, simulation for reliability analysis etc.

Unit 2: General Principles: Concepts in Discrete-Event Simulation, List Processing: properties and operations, data structures and dynamic allocation, techniques. **Simulation Software:** Selection of Simulation Software, review of some existing softwares like: Arena, AutoMod, Extend, Flexsim, Micro Saint, ProModel, Quest, SIMUL8, WITNESS etc., Experimentation and Statistical-Analysis Tools.

Unit 3: Statistical Models in Simulation: Useful Statistical Models, Discrete Distribution s, Continuous Distributions, Poisson Process, Empirical Distributions. **Queuing Models:** Characteristics of Queuing systems, Queuing Notation, Long Run Measures of performance of Queuing Systems, Steady State Behavior of infinite Population Markovian Models, Steady State Behavior of finite Population Models, Networks of Queues.

Unit 4: Random Number Generation: Properties of Random Numbers, Generation of Pseudo-Random Numbers, Techniques for Generating Random Numbers, Tests for Random Numbers, Inverse transform Techniques, Convolution Methods, and Acceptance –Rejection Techniques.

Unit 5:Input Modeling: Data collection, Identifying the Distribution with Data: Histograms, Selection of the Appropriate Family of Distributions, Quantile-Quantile Plots. Parameter Estimation: Sample Mean and Sample Variance and various biased and unbiased Estimators. Goodness of Fit Tests, Multivariate and Time-Series Input Models . **Verification and Validation of Simulation Models:** Model Building, Verification & Validation, Verification of simulation Models, Calibration & Validation of Models.

Suggested Readings/ Books:

1. Jerry Banks, John S. Carson II, Barry L. Nelson and David M. Nicol, Discrete-Event System and Simulation, Prentice Hall of India, New Delhi, 2005.

2. Deo Narsingh, "System Simulation with Digital Computers", PHI, New Delhi 1993.

3. Gordon G, "System Simulation", PHI 2nd Edition 1998.

4. Gabriel A. Wainer, Discrete-event modeling and simulation: a practitioner's approach, CRC Press, 2009.

5. K S Trivedi, "Probability and Statistics with Reliability, Queuing and Computer Science Application", PHI

6. Kleinrock, L.: Queuing Systems Vol.I, Vol.II, Wiley & Sons, London, 1975

INTERNET OF THING (OE-CS 602)

Course Outcomes:-

CO1:-To understand the fundamental concepts of IoT and apply them.

CO2:-To know the different hardware's used to embed them with IoT for the development of embedded applications.

CO3:-To learn the networking and communication aspects in IoT and analysis of different protocol used in IoT.

CO4:-Design and develop an application of IOT using ardunio platform.

CO5:-To comprehend the challenges faced for the development of an IoT application.

Unit I .

Internet of Things (IoT): Vision, Definition, Conceptual Framework, Architectural view, technology behind IoT, Sources of the IoT, M2M Communication, IoT Examples . Design Principles for Connected Devices: IoT/M2M systems layers and design standardization, communication technologies, data enrichment and consolidation, ease of designing and affordability.

Unit II

Hardware for IoT: Sensors, Digital sensors, actuators, radio frequency identification (RFID) technology, wireless sensor networks, participatory sensing technology. Embedded Platforms for IoT: Embedded computing basics, Overview of IOT supported Hardware platforms such as Arduino, NetArduino, Raspberry pi, Beagle Bone, Intel Galileo boards and ARM cortex.

Unit III

Network & Communication aspects in IoT: Wireless Medium access issues, MAC protocol survey, Survey routing protocols, Sensor deployment & Node discovery, Data aggregation & dissemination

Unit IV

Programming the Ardunio: Ardunio Platform Boards Anatomy, Ardunio IDE, coding, using emulator, using libraries, additions in ardunio, programming the ardunio for IoT.

Unit V

Challenges in IoT Design challenges: Development Challenges, Security Challenges, Other challenges IoT Applications : Smart Metering, E-health, City Automation, Automotive Applications, home automation, smart cards, Communicating data with H/W units, mobiles, tablets, Designing of smart street lights in smart city.

References:

1.Olivier Hersent,DavidBoswarthick, Omar Elloumi"The Internet of Things key applications and protocols", willey

2. Jeeva Jose, Internet of Things, Khanna Publishing House

3. Michael Miller "The Internet of Things" by Pearson

4. Raj Kamal "INTERNET OF THINGS", McGraw-Hill, 1ST Edition, 2016

5. ArshdeepBahga, Vijay Madisetti" Internet of Things(A hands on approach)" 1ST edition, VPI publications,2014

6. Adrian McEwen,HakinCassimally "Designing the Internet of Things" Wiley India

OE-EE-601	Electrical and Hybrid Vehicles	L-T-P-C: 3-0-0-3
Course Outcomes: At the end of this course students will demonstrate the ability to		
CO1	Understand the models used to describe hybrid vehicles and their performance.	
CO2	To comprehend electric and hybrid drive train topologies	
CO3	To realize different possible ways of energy storage	
CO4	Understand the different strategies of energy management	

UNIT I Introduction

Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, mathematical models to describe vehicle performance.

Introduction to Hybrid Electric Vehicles: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies.

Hybrid Electric Drive-trains: Basic concept of hybrid traction, introduction to various hybrid drive train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.

UNIT II Electric Trains

Electric Drive-trains: Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis. Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency

UNIT III Energy Storage

Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices. Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications, supporting subsystems

UNIT IV Energy Management Strategies

Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies. Case Studies: Design of a Hybrid Electric Vehicle (HEV), Design of a Battery Electric Vehicle (BEV).

Text / References:

1. A. K. Sawhney, "A Course in Electrical Machine Design", DhanpatRai and Sons, 1970.

2. M.G. Say, "Theory & Performance & Design of A.C. Machines", ELBS London.

3. S. K. Sen, "Principles of Electrical Machine Design with computer programmes", Oxford and IBH Publishing, 2006.

4. K. L. Narang, "A Text Book of Electrical Engineering Drawings", SatyaPrakashan, 1969.

5. A. Shanmugasundaram, G. Gangadharan and R. Palani, "Electrical Machine Design Data Book", New Age International, 1979.

6. K. M. V. Murthy, "Computer Aided Design of Electrical Machines", B.S. Publications, 2008.

7. Electrical machines and equipment design exercise examples using Ansoft's Maxwell 2D machine design package.

OE-EE-602	Nano-electronics	L-T-P-C: 3-0-0-3
Course Outcomes: At the end of this course students will demonstrate the ability to		
CO1	Understand various concepts of nano-technology	
CO2	Comprehend the processes involved in making nano components and material	
CO3	Leverage advantages of the nano-materials and appropriate use in solving practical problems	

UNIT I

Introduction to nanotechnology, meso structures, Basics of Quantum Mechanics: Schrodinger equation, Density of States.

UNIT II

Particle in a box Concepts, Degeneracy- Band Theory of Solids.KronigPenny Model. Brillouin Zones.

UNIT III

Shrink-down approaches: Introduction, CMOS Scaling, The nanoscale MOSFET, Finfets, Vertical MOSFETs, limits to scaling, system integration limits (interconnect issues etc.),

UNIT IV

Resonant Tunneling Diode, Coulomb dots, Quantum blockade, Single electron transistors,Carbon nanotube electronics, Bandstructure and transport, devices, applications, 2D semiconductors and electronic devices, Graphene, atomistic simulation

Text/ Reference Books:

1. G.W. Hanson, Fundamentals of Nanoelectronics, Pearson, 2009.

2. W. Ranier, Nanoelectronics and Information Technology (Advanced Electronic Materialand Novel Devices), Wiley-VCH, 2003.

3. K.E. Drexler, Nanosystems, Wiley, 1992.

4. J.H. Davies, The Physics of Low-Dimensional Semiconductors, Cambridge University Press, 1998.

5. C.P. Poole, F. J. Owens, Introduction to Nanotechnology, Wiley, 2003

OPEN ELECTIVE –III

OEC	Finite Element Analysis	OE-CE 701	3 1 0	4 CREDITS
COURSE OUTCOMES:				
CO1	Develop the ability to solve complex problems using finite no of elements by any standard FEM software or even by self developed programs.			
CO2	Implement numerical methods to solve mechanics of solids problems.			
CO3	Formulate and Solve axially loaded bar Problems.Formulate and analyze truss and beam problems.			
CO4	Implement the formulation techniques to solve two-dimensional problems using triangle and quadrilateral elements.			
CO5	Formulate and solve Axi-symmetric and heat transfer problems.			

UNIT - I

Introduction to Finite Element Analysis: Introduction Basic Concepts of Finite Element Analysis Introduction to Elasticity Steps in Finite Element Analysis
Finite Element Formulation Techniques: Virtual Work and Variational Principle, Galerkin Method, Finite Element Method: Displacement Approach, Stiffness Matrix and Boundary Conditions

UNIT - 2

Element Properties: Natural Coordinates, Triangular Elements, Rectangular Elements, Lagrange and Serendipity Elements, Solid Elements, Iso parametric Formulation, Stiffness Matrix of Iso parametric Elements, Numerical Integration: One Dimensional. Numerical Integration: Two and Three dimensional

UNIT - 3

Analysis of Frame Structures: Stiffness of Truss Members, Analysis of Truss, Stiffness of Beam Members, Finite Element Analysis of Continuous Beam, Plane Frame Analysis, Analysis of Grid and Space Frame

UNIT – 4

FEM for Two and Three Dimensional Solids: Constant Strain Triangle, Linear Strain Triangle, Rectangular Elements, Numerical Evaluation of Element Stiffness, Computation of Stresses, Geometric Nonlinearity and Static Condensation

UNIT - 5

Axi symmetric Element: Finite Element Formulation of Axi symmetric Element, Finite Element Formulation for 3 Dimensional Elements Introduction to Plates and Shells

Text Book:

- C.S.Desai & J.F.Abel Introduction to Finite Element Method, CBS Publishers & Distributors – Volume 58, Issue 1 (2001). Reference Books:
- O.C.Zienkiewicz Finite Element Method for Engineers and scientists McGraw-Hill (2013). □ K.J.Bathe & E.L.Wilson Numerical Methods in Finite Element Analysis – (2014).
- S.S. Rao Finite Element Method in Engineering Butterworth-Heinemann (2011)

OEC	Environmental Impact Analysis	OE-CE 702	3 1 0	4 CREDITS
COURSE OUTCOMES:				
CO1	Understand various EIA factors. Learn the basics relationship of Environment Impact Analysis			
CO2	Understand the EIA methodologies. Learn different aspects of Environmental Audit			
CO3	Understand the Different Environmental Management Plan			
CO4	Understand the concept of Ecological Foot Print and Carbon Trading			

Unit I

Environmental impact assessment (EIA), definitions and concepts, rationale and historical development of EIA, EIA in Civil Engineering,

Unit II

Initial environmental examination, environmental impact statement, environmental appraisal, environmental impact factors and areas of consideration, measurement of environmental impact, organization, scope and methodologies of EIA, status of EIA in India

Unit III

Environmental Management :- principles, problems and strategies; Review of political, ecological and remedial actions; future strategies; multidisciplinary environmental strategies, the human, planning, decision-making and management dimensions.

Unit IV

Environmental audit, definitions and concepts, partial audit, compliance audit, methodologies and regulations; introduction to ISO and ISO 14000; Life cycle assessment; Triple bottom line approach; Industrial Ecology; Ecological foot printing; Carbon trading; Sustainable development

Reference/ Text Books:

- Rau, G.J. and Wooten, C.D., Environmental Impact Analysis Handbook, New York: McGraw Hill; 1980.
- Canter R.L. “Environmental Impact Assessment” New Delhi: McGraw Hill Inc.; 1996.
- Shukla S.K. and Srivastava, P.R., “Concepts in Environmental Impact Analysis”, New Delhi: Common Wealth Publishers; 1992.

OE-EC 701 Digital System Design using VHDL

L-T-P-C
3-0-0-3

Course Outcomes: After the successful completion of the course the students will be able to:

1. Develop a digital logic and apply it to solve real life problems.
2. Analyze, design and implement combinational logic circuits.
3. Classify different semiconductor memories.
4. Analyze, design and implement sequential logic circuits.
5. Simulate and implement combinational and sequential circuits using VHDL systems.

Unit-1

Principles of combinational logic: Review of Boolean Algebra. Definition of combinational, Canonical forms, Generation of switching equations from truth tables, Karnaugh maps-3, 4 and 5 variables. Incompletely specified functions (Don't care terms). Simplifying max – term equations. Quine - McClusky minimization technique, Quine – McClusky using don't care terms, Reduced Prime Implicant tables, Map entered variables

Unit-2

Analysis and design of Combinational Logic: General approach, Decoders-BCD decoders, Encoders. Digital multiplexers-using multiplexers as Boolean function generators. Adders and Subtractors-Cascading full adders, Look ahead carry adder, Binary comparators.

Unit-3

Sequential Circuits: Basic Bi-stable element, Latches, SR latch, Application of SR latch, A Switch debouncer. The SR latch, The gated SR latch. The gated D Latch, The Master-Slave Flip-Flops (Pulse-Triggered Flip-Flops): The master-slave SR Flip-Flops, The master-slave JK Flip-Flop, Edge Triggered Flip-flop: The Positive Edge-Triggered D Flip-Flop, Negative-Edge Triggered D Flip-Flop. Characteristic equations, Registers, Counters-Binary Ripple Counter, Synchronous Binary counters, Counters based on Shift Registers, Design of a Synchronous counters, Design of a Synchronous Mod-N counters using clocked JK Flip-Flops Design of a Synchronous Mod-N counter using clocked D, T, or SR Flip-Flops

Unit-4

Sequential Design: Introduction, Mealy and Moore models, State machine notation, synchronous sequential circuit analysis and design. Construction of state Diagrams, Counters Design.

Unit-5

HDL: Introduction, A brief history of HDL, Structure of HDL Module, Operators, Data types, Types of Descriptions, Simulation and synthesis, Brief comparison of VHDL and Verilog. Data-Flow Descriptions: Highlights of Data flow descriptions, Structure of data-flow description, Data type-vectors.

Text/Reference Books:

1. Digital Logic Applications and Design John M Yarbrough Cengage Learning 2011
2. Digital Principles and Design Donald D Givone McGraw Hill Education 1 st Edition, 2002
3. Logic and computer design Fundamentals M. Morries Mano and Charles Kime Pearson Learning 4 th Edition, 2014
4. Circuit Design and Simulation with VHDL Volnei A Pedroni PHI 2nd Edition,
5. Fundamentals of logic design Charles H Roth, JR and Larry L. Kinney Cengage Learning 6th Edition, 2013
6. Fundamentals of Digital Circuits A. Anand Kumar PHI 3rd Edition, 2014
7. Digital Logic Design and VHDL A.A.PhadkeS.M.Deokar Wiley India 1st Edition, 2009
8. Digital Circuits and Design D.P.KothariJ.S.Dhillon Pearson First Print 2015
9. HDL Programming (VHDL and Verilog) Nazeih M. BotrosCengage Learning 1st Edition, 2011

OE-EC 702 Micro-Electro Mechanical Systems

L-T-P-C
3-0-0-3

Course Outcomes: After the successful completion of the course the students will be able to:

1. Gain knowledge of basic approaches for micro/Nano system design.
2. Understanding the concept of state-of-the-art lithography techniques for micro/Nano systems.
3. Aanalyze the Interfacing of Sensors, Actuators using appropriate DAQ micro-controller.
4. Learn new materials, science and technology for micro/Nano system applications.
5. Understand state-of-the-art micromachining and packaging technologies.

Unit-1

Introduction: Overview of MEMS and Microsystems: MEMS and Microsystem, Typical MEMS and Microsystems Products, Evolution of Micro-fabrication, Microsystems and Microelectronics, Multidisciplinary Nature of Microsystems, Miniaturization. Applications and Markets

Unit-2

Working Principles of Microsystems: Introduction, Microsensors, Microactuation, MEMS with Microactuators, Microaccelerometers, Microfluidics.

Unit-3

Material Processing: Silicon Wafer processing, Lithography, Thin-Film Deposition, Etching (Wet and Dry), Wafer Bonding and Metallization, Thick film processing, Smart Material processing, Emerging trends

Unit-4

Electronic circuit and Control: Carrier concentration, semiconductor diodes, transistor, MOSFET, Introduction to operational amplifier, Examples from Micro system, Transfer Function, state space modeling model order reduction, examples from smart systems

Unit-5

Micro-manufacturing, Integration and Packaging: Introduction, Bulk Micro-manufacturing, Surface Micromachining, The LIGA Process ,Integration and Packaging of Micro-electromechanical systems.

Text/Reference Books:

1. MEMS, NitaigourPremchandMahalik, TMH Publishing co.
2. Foundation of MEMS, Chang Liu, Prentice Hall Ltd.
3. MEMS and NEMS, Sergey EdwrdLyshevski, CRC Press, Indian Edition.
4. MEMS and Micro Systems: Design and Manufacture, Tai-Ran Hsu, TMH Publishers.
5. Introductory MEMS, Thomas M Adams, Richard A Layton, Springer International Publishers.

Non-Conventional Energy Resources (OE-ME 701)

L T P C

3 0 0 3

Prerequisite: Basic Knowledge of Power Plant Engineering.

Couse Outcomes (COs):

1. Illustrate the generation of electricity from various Non-Conventional sources of energy, have a working knowledge on types of fuel cells.
2. Study the solar energy, Utilization of it, Principles involved in solar energy collection and conversion of it to electricity generation.
3. Study the working principle of geothermal energy,Magneto-hydrodynamics (MHD) and fuel cell technology for energy generation.
4. Explore the concepts involved in wind energy conversion system by studying its components, types and performance.
5. Study the working principle of bio mass, wave and tidal wave and OTEC.

Course Contents:

Unit I

Introduction: Various non-conventional energy resources- Introduction, availability, classification, relative merits and demerits.

Solar Cells: Theory of solar cells. solar cell materials, solar cell array, solar cell power plant, limitations.

UNIT II

Solar Thermal Energy: Solar radiation, flat plate collectors and their materials, applications and performance, focusing of collectors and their materials, applications and performance; solar thermal power plants, thermal energy storage for solar heating and cooling, limitations.

UNIT III

Geothermal Energy: Resources of geothermal energy, thermodynamics of geo-thermal energy conversion-electrical conversion, non-electrical conversion, environmental considerations.

Magneto-hydrodynamics (MHD): Principle of working of MHD Power plant, performance and limitations.

Fuel Cells: Principle of working of various types of fuel cells and their working, performance and limitations.

UNIT IV

Thermo-electrical and thermionic Conversions: Principle of working, performance and limitations.

Wind Energy: Wind power and its sources, site selection, criterion, momentum theory, classification of rotors, concentrations and augments, wind characteristics. performance and limitations of energy conversion systems.

UNIT V

Bio-mass: Availability of bio-mass and its conversion theory.

Ocean Thermal Energy Conversion (OTEC): Availability, theory and working principle, performance and limitations.

Wave and Tidal Wave: Principle of working, performance and limitations. Waste Recycling Plants.

Text Books:

1. Raja etal, "Introduction to Non-Conventional Energy Resources" Scitech Publications.
2. D.S. Chauhan,"Non-conventional Energy Resources" New Age International.
3. C.S. Solanki, "Renewal Energy Technologies: A Practical Guide for Beginners" PHI Learning.

Reference Books:

1. John Twideu and Tony Weir, "Renewal Energy Resources" BSP Publications, 2006.
2. M.V.R. Koteswara Rao, "Energy Resources: Conventional & Non-Conventional " BSP Publications,2006.

Nanotechnology (OE-ME 702)

L T P C

3 0 0 3

Prerequisite: Basic Knowledge of Materials Science.

Course Outcomes (COs):

After completion of this course student will be able to:

1. Explain the fundamental principles of nanotechnology and their application to engineering.
2. Apply engineering and physics concepts to the Nano-scale and non-continuum domain.
3. Study the properties of individual Nano particles, metal Nano clusters and semi conducting nanomaterial.
4. Discuss and evaluate state-of-the-art characterization methods for nanomaterial, and determine nanomaterial safety and handling methods required during characterization.
5. Explain methods of fabricating nanostructures of carbon Buckey Ball, Carbon nano-tubes

Course Contents:

Unit I

Introduction: Definition of Nano-Science and Nano Technology, Applications of Nano-Technology.

Introduction to Physics of Solid State:Structure: Size dependence of properties; crystal structures, face centered cubic nanoparticles; Tetrehedrally bounded semiconductor structures; lattice vibrations. **Energy Bands:** Insulators, semiconductor and conductors; Reciprocal space; Energy bands and gaps of semiconductors; effective masses; Fermi Surfaces.

Localized Particles: Acceptors and deep taps; mobility; Excitons.

Unit II

Quantum Theory For Nano Science: Time dependent and time independent Schrodinger wave equations. Particle in a box, Potential step: Reflection and tunneling (Quantum leak). Penetration of Barrier, Potential box(Trapped particle in 3D:Nanodot), Electron trapped in 2D plane(Nano sheet), Quantum confinement effect in nano-materials.

Quantum Wells, Wires and Dots: Preparation of Quantum Nanostructure; Size and Dimensionality effect, Fermigas; Potential wells; Partial confinement; Excitons; Single electron Tunneling, Infrared etectors; Quantum dot laser Superconductivity.

Properties of Individual Nano particles,Metal Nano clusters: Magic Numbers; Theoretical Modelling of Nanopraticles; geometric structure; electronic structure; Reactivity; Fluctuations Magnetic Clusters; Bulle to Nano structure.

Semi conducting Nanoparticles: Optical Properties; Photofragmentation; Coulmbic explosion.

Rare Gas & Molecular Clusters: Inert gas clusters; Superfluid clusters molecular clusters.

Unit III

Growth Techniques of Nanomaterials: Lithograpahic and Nonlithograpahic techniques, Sputtering and film deposition in glow discharge, DC sputtering technique (p-$CuAlO_2$ deposition). Thermal evaporation technique, E-beam evaporation, Chemical Vapour deposition(CVD), Synthesis of carbon nano-fibres and multi-walled carbon nanotubes, Pulsed Laser Deposition, Molecular beam Epitoxy, Sol-Gel Techniuqe (No chemistry required), Synthesis of nanowires/rods, Electrodeposition, Chemical bath deposition, Ion beam deposition system, Vapor-Liquid –Solid (VLS) method of nanowires. **8**

Unit IV

Methods of Measuring Properties:Structure: Crystallography, particle size determination, surface structure,

Microscopy: Scanning Prob Microscopy (SPM), Atomic Force Microscopy (AFM), Field Ion Microscopy, Scanning Electron Microscopy, Transmission Elecrtron Microscopy (TEM)

Spectroscopy: Infrared and Raman Spectroscopy, X-ray Spectroscopy, Magnetic resonance, Optical and Vibrational Spectroscopy, Luninscence.

Unit V

Buckey Ball: Nano structuresofcarbon(fullerene): **Carbon nano-tubes:** Fabrication , structure. electrical, mechanical, and vibrational properties and applications. Nano diamond, Boron Nitride Nano-tubes, single elecron transistors, Moelcular machine, Nano-Biometrics, Nano Robots.

Text Books:

1. A.K.Bandyopadhyay, “Nano Materials” New Age International.
2. “Introduction to S.S. Physics” - (7^{th} Edn.) Wiley 1996.

Reference Books:

1. C.P.PooleJr F.J. Owens, “Introduction to Nanotechnology”. (5).
2. S. Sugano & H. Koizuoni, “Microcluster Physics” –Springor 1998.
3. “Handboole of Nanostructured Materials & Nanotechnology” vol.-5. Academic Press 2000.

Non-Destructive Evaluation (OE-ME 703)

L T P C

3 0 0 3

Prerequisite: Basic Knowledge of Material Science and Engineering.

Course Outcomes (COs):

After completion of this course student will be able to:

1. Obtain the fundamental knowledge about different NDT methods and visual inspection.
2. Explain the principles and testing knowledge of DPT(liquid penetrate inspection) and MPT for product testing.
3. Explain the principles and techniques in Radiography Testing.
4. Describe the knowledge about Ultrasonic Testing for products.
5. Understand the materials and testing procedure for Eddy Current Inspection&Thermography Testing.

Course Contents:

Unit I

Introduction:Scope and advantages of NDT, Comparison of NDT with Destructive Testing, some commonNDT methods used since ages, Terminology, Flaws and Defects, Visual inspection, Equipmentused for visual inspection. Ringing test, chalk test (oil whitening test). Uses of visual inspectiontests in detecting surface defects and their interpretation, advantages &limitations of visual inspection.

Unit II

Tests: Die penetrate test (liquid penetrate inspection), Principle, scope. Equipment & techniques, Test stations, Advantages, types of penetrants and developers, Zyglo test, Illustrative examples andinterpretation of defects.Magnetic particle Inspection – scope and working principle, Ferro Magnetic and Nonferromagnetic materials, equipment & testing. Advantages, limitations Interpretation of results,DC& AC magnetization, Skin Effect, use of dye & wet powders for magna glow testing,different methods to generate magnetic fields, Applications.

Unit III

Radiographic methods: Introduction to electromagnetic waves and radioactivity, various decays, Attenuation ofelectromagnetic radiations, Photo electric effect, Rayleigh's scattering (coherent scattering),Compton's scattering (Incoherent scattering), Pair production, Beam geometry and

Scatteringfactor. X-ray radiography: principle, equipment & methodology, applications, types of radiations andlimitations. γ-ray radiography – principle, equipment., source of radioactive materials &technique, advantages of γ-ray radiography over X-ray radiography Precautions against radiationhazards. Case Study - casting and forging.

Unit IV

Ultrasonic testing methods: Introduction, Principle of operation, Piezoelectricity. Ultrasonic probes, CRO techniques,advantages, Limitation & typical applications. Applications in inspection of castings, forgings,Extruded steel parts, bars, pipes, rails and dimensions measurements. Case Study – Ultrasonography of human body.

Unit V

Special NDT Techniques: Eddy Current Inspection: Principle, Methods, Equipment for ECT, Techniques, Sensitivity,advanced ECT methods. Application, scope and limitations, types of Probes and Case Studies.Introduction to Holography, Thermography and Acoustic emission Testing.

Text Books:

1. Non-Destructive Testing and Evaluation of Materials, by- Prasad, McGraw Hill Education
2. Practical Non-destructive Testing, by- Baldev Raj, T. Jayakumar, M. Thavasimuthu, WoodheadPublishing.
3. Non-Destructive Testing Techniques, by- Ravi Prakash, New Age International.

Reference Books

1. Nondestructive Testing Handbook,by Robert C. McMaster, American Society for Nondestructive.
2. Introduction to Nondestructive Testing: A Training Guide, by- Paul E. Mix, wiley.
3. Electrical and Magnetic Methods of Non-destructive Testing, by- J. Blitz, springer.
4. Practical non destructive testing by Raj, Baldev.
5. Basics of Non-Destructive Testing, by Lari& Kumar, KATSON Books.

Introduction to Mechanical Micro Machining (OE-ME 704)

L T P C

3 0 0 3

Prerequisite: Basic Knowledge of Conventional machining processes..

Course Outcomes (COs):

1. Understand of process of Ultra Sonic Micro Machining, Abrasive Jet Micro Machining, Water Jet Micro Machining etc.
2. Explain the Beam Energy based micro machining, Electron Beam Micro Machining, Laser Beam Micro Machining, Electric Discharge Micro Machining etc.
3. To understand the Magneto Rheological abrasive flow finishing, Magnetic Float polishing, Elastic Emission Machining etc.
4. Understand of Micro bending with LASER, LASER micro welding, Electron beam for micro welding.
5. Understand the Metrology for micro machined components and Machining of Micro gear, micro nozzle, micro pins, Applications.

Course Contents:

UNIT I

MICRO MACHINING: Ultra Sonic Micro Machining, Abrasive Jet Micro Machining, Water Jet Micro Machining, Abrasive Water Jet Micro Machining, Micro turning, Chemical and Electro Chemical Micro Machining, Electric discharge micro machining.

UNIT II

MICRO MACHINING: Beam Energy based micro machining, Electron Beam Micro Machining, Laser Beam Micro Machining, Electric Discharge Micro Machining, Ion Beam Micro Machining, Plasma Beam Micro Machining, Hybrid Micro machining, Electro Discharge Grinding, Electro Chemical spark micro machining, Electrolytic in process Dressing.

UNIT III

NANO POLISHING: Abrasive Flow finishing, Magnetic Abrasive Finishing, Magneto rheological finishing, Magneto Rheological abrasive flow finishing, Magnetic Float polishing, Elastic Emission Machining, chemo-mechanical Polishing.

UNIT IV

MICRO FORMING AND WELDING: Micro extrusion, Micro and Nano structured surface development by Nano plastic forming and Roller Imprinting, Micro bending with LASER, LASER micro welding, Electron beam for micro welding.

UNIT V

RECENT TRENDS AND APPLICATIONS: Metrology for micro machined components, Ductile regime machining, AE based tool wear compensation, Machining of Micro gear, micro nozzle, micro pins, Applications.

Text Books:

1. Jain V. K., Micro Manufacturing Processes, CRC Press, Taylor & Francis Group, 2012.
2. Jain V.K., _Introduction to Micro machining‘ Narosa Publishing House, 2011
3. Jain V.K., Advanced Machining Processes, Allied Publishers, Delhi, 2002.

Reference Books:

1. Janocha H., Actuators – Basics and applications, Springer publishers – 2012
2. Bharat Bhushan, Handbook of nanotechnology, springer, Germany, 2010.
3. Bandyopadhyay. A.K., Nano Materials, New age international publishers, New Delhi, 2008, ISBN:8122422578.
4. Mcgeoug.J.A., Micromachining of Engineering Materials, CRC press 2001, ISBN-10:0824706447.

Data science (OE-CS 701)

Course Outcomes

CO1.Describe what Data Science is and the skill sets needed to be a data scientist. • Explain in basic terms what Statistical Inference means. Identify probability distributions commonly used as foundations for statistical modeling. Fit a model to data.

CO2. Use R to carry out basic statistical modeling and analysis.

CO3. Explain the significance of exploratory data analysis (EDA) in data science. Apply basic tools (plots, graphs, summary statistics) to carry out EDA.

CO4. Describe the Data Science Process and how its components interact

CO5 Use APIs and other tools to scrap the Web and collect data. And Apply EDA and the Data Science process in a case study.

Unit 1. Introduction: What is Data Science? - Big Data and Data Science hype – and getting past the hype - Why now? – Datafication - Current landscape of perspectives - Skill sets needed . Statistical Inference - Populations and samples - Statistical modeling, probability distributions, fitting a model - Intro to R

Unit 2. Exploratory Data Analysis and the Data Science Process - Basic tools (plots, graphs and summary statistics) of EDA - Philosophy of EDA - The Data Science Process - Case Study: RealDirect (online real estate firm) Three Basic Machine Learning Algorithms - Linear Regression - k-Nearest Neighbors (k-NN) - k-means

Unit 5. One More Machine Learning Algorithm and Usage in Applications - Motivating application: Filtering Spam - Why Linear Regression and k-NN are poor choices for Filtering Spam - Naive Bayes and why it works for Filtering Spam - Data Wrangling: APIs and other tools for scrapping the Web Feature Generation and Feature Selection (Extracting Meaning From Data) - Motivating application: user (customer) retention - Feature Generation (brainstorming, role of domain expertise, and place for imagination) - Feature Selection algorithms – Filters; Wrappers; Decision Trees; Random Forests

Unit 4 Recommendation Systems: Building a User-Facing Data Product - Algorithmic ingredients of a Recommendation Engine - Dimensionality Reduction - Singular Value Decomposition - Principal Component Analysis - Exercise: build your own recommendation system 8. Mining Social-Network Graphs - Social networks as graphs - Clustering of graphs - Direct discovery of communities in graphs - Partitioning of graphs - Neighborhood properties in graphs

Unit 5. Data Visualization - Basic principles, ideas and tools for data visualization 3 - Examples of inspiring (industry) projects - Exercise: create your own visualization of a complex dataset 10. Data Science and Ethical Issues - Discussions on privacy, security, ethics - A look back at Data Science - Next-generation data scientists

References

Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk From The Frontline. O'Reilly. 2014.

• Jure Leskovek, Anand Rajaraman and Jeffrey Ullman. Mining of Massive Datasets. v2.1, Cambridge University Press. 2014. (free online)

• Kevin P. Murphy. Machine Learning: A Probabilistic Perspective. ISBN 0262018020. 2013.

• Foster Provost and Tom Fawcett. Data Science for Business: What You Need to Know about Data Mining and Data-analytic Thinking. ISBN 1449361323. 2013.

• Trevor Hastie, Robert Tibshirani and Jerome Friedman. Elements of Statistical Learning, Second Edition. ISBN 0387952845. 2009. (free online)

• Avrim Blum, John Hopcroft and Ravindran Kannan. Foundations of Data Science

• Mohammed J. Zaki and Wagner Miera Jr. Data Mining and Analysis: Fundamental Concepts and Algorithms. Cambridge University Press. 2014.

• Jiawei Han, Micheline Kamber and Jian Pei. Data Mining: Concepts and Techniques, Third Edition. ISBN 0123814790. 2011.

BIG DATA ANALYTICS (OE-CS 702)

COURSE OUTCOMES:

CO1:- To know the fundamental concepts of big data and analytics.

CO2:- To understand the different way to classify the given data using different techniques.

CO3:- To explore tools and practices for working with big data

CO4:- To learn about stream computing.

CO5:- To know about the research that requires the integration of large amounts of data.

UNITI

INTRODUCTION TO BIGDATA

Evolution of Big data - Best Practices for Big data Analytics - Big data characteristics - Validating - The Promotion of the Value of Big Data - Big Data Use Cases- Characteristics of Big Data Applications - Perception and Quantification of Value -Understanding Big Data Storage - A General Overview of High- Performance Architecture - HDFS - MapReduce and YARN - Map Reduce Programming Model

UNIT III

ASSOCIATION AND RECOMMENDATIONSYSTEM

Advanced Analytical Theory and Methods: Association Rules - Overview - Apriori Algorithm - Evaluation ofCandidateRules - Applications of Association Rules - Finding Association& finding similarity.

Recommendation System: Collaborative Recommendation- Content Based Recommendation - Knowledge Based Recommendation- Hybrid RecommendationApproaches.

UNIT IV

STREAMMEMORY

Introduction to Streams Concepts – Stream Data Model and Architecture - Stream Computing, Sampling Data in a Stream – Filtering Streams – Counting Distinct Elements in a Stream – Estimating moments – Counting oneness in a Window – Decaying Window – Real time Analytics Platform(RTAP) applications - Case Studies - Real Time Sentiment Analysis, Stock Market

Predictions. Using Graph Analytics for Big Data: GraphAnalytics

UNIT V

NOSQL DATA MANAGEMENT FOR BIG DATAAND VISUALIZATION

NoSQL Databases : Schema-less Models‖: Increasing Flexibility for Data Manipulation-Key Value Stores- Document Stores - Tabular Stores - Object Data Stores - Graph Databases Hive - Sharding –- Hbase – Analyzing big data with twitter - Big data for E-Commerce Big data for blogs - Review of Basic Data Analytic Methods using R.

TEXT BOOKS:

1. AnandRajaraman and Jeffrey David Ullman, "Mining of Massive Datasets", Cambridge University Press, 2012.

2. David Loshin, "Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph", Morgan Kaufmann/El sevier Publishers, 2013.

OE-CS 703	**Artificial Intelligence**	**3L-0T-0P**	**CREDIT -3**

Course outcome expected:

By end of this course the student should be able to

CO1: To Demonstrate knowledge of the building blocks of AI as presented in terms of intelligent agents. Apply concept of Natural Language processing to problems leading to understanding of cognitive computing.

CO2: To Analyze and formalize the problem as a state space, graph, design heuristics and select amongst different search or game based techniques to solve them.

CO3: Develop intelligent algorithms for constraint satisfaction problems and also design intelligent systems for Game Playing.

CO4: To study and apply the basic issues of knowledge representation and Logic and blind and heuristic search, as well as an understanding of other topics such as chaining, resolution, etc. that play an important role in AI programs.

CO5: To understand various machine learning techniques and models.

SYLLABUS

UNIT I Introduction: Introduction to Artificial Intelligence, Foundations and History of Artificial Intelligence, Applications of Artificial Intelligence, Intelligent Agents, Structure of Intelligent Agents. Computer vision, Natural Language Possessing.

Unit II Introduction to Search : Searching for solutions, Uniformed search strategies, Informed search strategies, Local search algorithms and optimistic problems, Adversarial Search, Search for games, Alpha - Beta pruning

Unit III Knowledge Representation & Reasoning: Propositional logic, Theory of first order logic, Inference in First order logic, Forward & Backward chaining, Resolution, Probabilistic reasoning, Utility theory, Hidden Markov Models (HMM), Bayesian Networks.

Unit IV Machine Learning : Supervised and unsupervised learning, Decision trees, Statistical learning models, Learning with complete data - Naive Bayes models, Learning with hidden data - EM algorithm, Reinforcement learning,

Unit V Pattern Recognition : Introduction, Design principles of pattern recognition system, Statistical Pattern recognition, Parameter estimation methods - Principle Component Analysis (PCA) and Linear Discriminant Analysis (LDA), Classification Techniques – Nearest Neighbor (NN) Rule, Bayes Classifier, Support Vector Machine (SVM), K – means clustering.

Text books:

1. Stuart Russell, Peter Norvig, “Artificial Intelligence – A Modern Approach”, Pearson Education

2. Elaine Rich and Kevin Knight, “Artificial Intelligence”, McGraw-Hill

3. E Charniak and D McDermott, “Introduction to Artificial Intelligence”, Pearson Education

4. Dan W. Patterson, “Artificial Intelligence and Expert Systems”, Prentice Hall of India,

OE-EE 701	Machine learning and Python Programming	L-T-P-C: 3-0-0-3
Course Outcomes: At the end of this course students will demonstrate the ability to		
CO1	Do progamming with Python	
CO2	Apply Statistics to machine learning and know how it is different than descriptive statistics	
CO3	Build features that meet analysis needs and understand different approaches for creating predictive models	
CO4	Create and evaluate data clusters	
CO5	Apply Python for NLP	

UNIT I Python Fundamentals

The basic foundation of variables– Data types – Arithmetic, logical and comparison operator – Data types of Python List – Data Cleansing – Dictionary– Conditional and Iterative loops - Numpy Library - Data Manipulation using Pandas Library - Data Visualization - visualizations using Matplotlib and Seaborn Python libraries – Merging multiple datasets - Melting/changing dimensions of datasets

UNIT II Fundamentals of Statistics

Graphically Displaying Single Variable -Measures of Location - Measures of Spread - Displaying relationship – Bivariate Data – Scatterplot - Measures of association of two or more variables - Covariance and Correlation - Probability - Joint Probability and independent events - Conditional probability - Bayes' Theorem - Prior, Likelihood and Posterior - Discrete Random Variable - Probability Distribution of Discrete Random Variable - Binomial Distribution - Continuous Random Variables - Probability Distribution Function - Uniform Distribution - Normal Distribution - Point Estimation – Interval Estimation - Hypothesis Testing

UNIT III Machine learning with Python

Supervised and Unsupervised Learning - Python libraries suitable for Machine Learning
Regression – Features and Labels– Training and Testing– Forecasting and Predicting– Theory and how it works– to program Best Fit Slope – to program the Best Fit Line– R Squared and Coefficient of Determination Theory - Model evaluation methods
Classification: Applying K Nearest Neighbors to Data -Euclidean Distance theory -Decision Trees - Regression Trees - Random Forests - Boosting Algorithm - Principal Component Analysis - Linear Discriminant Analysis
Support Vector Machine Fundamentals - Constraint Optimization with Support Vector Machine - SVM Optimization in Python - Visualization and Predicting with our Custom SVM - Kernels - Soft Margin Support Vector Machine

UNIT IV Clustering

Handling Non-Numerical Data for Machine Learning - K-Means with Titanic Dataset - K-Means in Python - Hierarchical Clustering with Mean Shift Introduction - Naive Bayes Classifier - Naive Bayes Classifier with Scikit - Introduction into Text Classification using Naive Bayes - Python Implementation of Text Classification

UNIT V Introduction to NLP

Text Pre-processing, Noise Removal, Lexicon Normalization, Lemmatization, Stemming, Object Standardization- Text to Features (Feature Engineering on text data)-Syntactical Parsing, Dependency Grammar- Part of Speech Tagging - Entity Parsing- Phrase Detection - Named Entity Recognition - Topic Modelling - N-Grams - Statistical features - TF – IDF- Frequency / Density Features: Readability Features, Word Embedding

Important tasks of NLP: Text Classification, Text Matching, Levenshtein Distance, Phonetic Matching, Flexible String Matching - Important NLP libraries

Reference Books:

1. Introduction-to-Machine-Learning-with-Python, Andreas C. Muller and Sarah Guido, O'Reilly Books
2. Beginning Programming with Python For Dummies, John Paul Mueller

OEEE-702	Embedded Systems	L-T-P-C: 3-0-0-3
Course Outcomes: At the end of this course students will demonstrate the ability to		
CO1	Choose between design approaches using advanced controllers to real-life situations	
CO2	Design interfacing of the systems with other data handling / processing systems	
CO3	Appreciate engineering constraints like energy dissipation, data exchange speeds etc	
CO4	Understand software aspects of Embedded Systems	

UNIT I

The concept of embedded systems design, Embedded microcontroller cores, embedded memories. Examples of embedded systems.

UNIT II

Technological aspects of embedded systems: interfacing between analog and digital blocks, signal conditioning, digital signal processing.

UNIT III

Sub-system interfacing, interfacing with external systems, user interfacing

Design tradeoffs due to process compatibility, thermal considerations, etc.,

UNIT IV

Software aspects of embedded systems: real time programming languages and operating systems for embedded systems.

Text/Reference Books:

1. J.W. Valvano, "Embedded Microcomputer System: Real Time Interfacing", Brooks/Cole, 2000.

2. Jack Ganssle, "The Art of Designing Embedded Systems", Newness, 1999.

3. V.K. Madisetti, "VLSI Digital Signal Processing", IEEE Press (NY, USA), 1995.

4. David Simon, "An Embedded Software Primer", Addison Wesley, 2000.

5. K.J. Ayala, "The 8051 Microcontroller: Architecture, Programming, and Applications", Penram Intl, 1996.

OPEN ELECTIVE –IV

OEC	REMOTE SENSING AND GIS APPLICATION	OE-CE 801	3 1 0	4 CREDITS

COURSE OUTCOMES:	
CO1	Retrieve the information content of remotely sensed data
CO2	Understand characteristics of multi concept of remote sensing.
CO3	Interpret the images for preparation of thematic maps.
CO4	Understand the concept & terminology of GIS.
CO5	Apply the RS & GIS in real world problems.

Unit I

Remote Sensing: Introduction, sources of energy for remote sensing, active and passive sources, electromagnetic radiation, and their characteristics, thermal emission, Interaction of EMR with atmosphere, atmospheric windows, interaction of EMR with earth surface- spectral reflection curves.

Unit II

Multi concept of remote sensing, idealisms and real sequence of remote sensing, sensors and orbital characteristics, various sensing platforms for remote sensing, characteristics of various satellite, remote sensing data products and their uses.

Unit III

Digital image processing: Introduction, digital image representation, and Characterization, histograms and scatter plot, image enhancement, contrast stretching, Pattern recognition, and feature extraction, image classification: unsupervised and Supervised techniques

Unit IV

Geographic Information system: Introduction, concept and terminology, components of GIS, raster and Vector formats, scanners and digitizers, methods of digitization, data Preprocessing, form conversion, data reduction, and generalization

Unit V

Data merging, edge matching, registration and re-sampling, data manipulation and Analysis representation of real-world problems, problem solving and spatial modeling, classification, aggregation, overlay, buffers and indivisibility and its applications in planning of utility lines, flood studies, ground water recharge, erosion modeling,

References:

1. Remote Sensing and Image Interpretation – Lillesand and Kiefer, John Wiley & Sons Ltd.
2. Introduction to the physics and techniques of Remote Sensing – Elachi, John Wiley & Sons Ltd.
3. Geographical Information System Vol. I and II– Longley, John Wiley & Sons Ltd.
4. An Introduction to GIS – Ian Haywood, Dorlling Kindersley Pvt. Ltd.
5. Advanced Surveying by Satheesh, G., Sathikumar, R., and Madhu, N., Pearsons Educations

OEC	INFRASTRUCTURE ENGINEERING	OE-CE-802	3 1 0	4 CREDITS

COURSE OUTCOMES:	
CO1	Identify the elements of Building.
CO2	Identify waste water & water supply sources.
CO3	Understand about transportation infrastructure (Road, rail and air).
CO4	Analysis the various characteristics of Dam, Canal, Port, Hourber and Hydroelectric projects.
CO5	Introduction to architecture, land use planning.

Unit I

Building-

Elements- slab, beam, column, footing Types- Residential, Institutional, Commercial, Industrial Types of structure- Load bearing, framed, combined

Unit II
Water Supply and Wastewater Infrastructure

Water Supply- Source, demand, intake, transport, conduits, treatment, distribution, household plumbing
Waste Water- Collection, transport, treatment and disposal

Unit III
Transport Infrastructure: Road, rail and air

Road- Elements, types, traffic studies Rail- Gauge, components Air- Runway, planning, helipad

Unit IV
Irrigation, hydropower and navigation

Dam, canal, port, harbor, hydroelectric projects

Unit V Miscellaneous
Introduction to architecture, land use planning

References:

1. Peurify, RL, –Construction, Planning, Equipment and Methods|, Tata McGraw Hill Education
2. NPTEL E Learning course on Infrastructure Planning &Mangament.

OEC	Structural Dynamics	OE-CE 803	3 1 0	4 CREDITS
COURSE OUTCOMES:				
CO1	Understand the characteristics of earthquake.			
CO2	Understand the degree of freedom.			
CO3	Understand the theory of seismic			
CO4	Identify the two degree and multi degree freedom system.			
CO5	Understand the various techniques of structural analysis			

Unit I

Introduction: origin of earthquakes, magnitude, intensity, ground motions, sensors, strong motion characteristics. Theory of Vibrations: Introduction, Vibrations, Periodic motion, Earthquake loading on structures, structural idealization for dynamic analysis, free and forced vibrations of single degree, two degree and multi-degree freedom systems

Unit II

Single degree of freedom systems: equation of motion, free and forced vibrations, damping, response spectrum

Unit III

Theory of Seismic Pickups. Numerical Evaluation of Dynamic Response

Unit IV

Two degree and multidegree freedom systems

Unit V

Lagrange‘s equations and its applications, seismic coefficient method and average response spectrum techniques in structural analysis.

References

1. Agarwal, P. and Shrikhande, M., Earthquake resistant design of structures‖, PHI Publ. 2. Paz, M.,‖Structural dynamics – theory & computation‖, CBS Publs. 3. Chopra, A.K.,‖ Dynamics of structures theory and application of earthquake engineering‖, Prentice Hall 4. IS:1893 (Part-1) 5. IITK-BMTPC Earthquake tips

OE-EC 801 Advance Sensors and Transducers

L-T-P-C
4-0-0-4

Course Outcomes: At the end of the course, students will demonstrate the ability to:

1. Apply the mathematical knowledge and science & engineering fundamentals gained to solve problems pertaining to measurement applications.
2. Analyze the problems related to sensors & transducers.
3. Select the appropriate sensor/transducer for a given application.
4. Determine the static and dynamic characteristics of transducers using software packages.
5. Understand fiber optic sensor and applications. Ability to understand smart traducer and its standard.

Unit-1 (8 Hrs)
Science of measurements and classification of transducers: Units and standards, Static calibration, Classification of errors, Limiting error and probable error, Error analysis, Statistical methods , Odds and uncertainty, Classification of transducers, Selection of transducers.

Unit-2 (8 Hrs)
Characteristics of transducers: Static characteristics, Accuracy, precision, resolution, sensitivity, linearity, span and range. Dynamic characteristics, Mathematical model of transducer, Zero, I and II order transducers.

Unit-3 (8 Hrs)
Variable resistance transducers: Principle of operation, construction details, characteristics and applications of potentiometer, strain gauge, resistance thermometer, Thermistor, hot-wire anemometer, piezo-resistive sensor and humidity sensor.

Unit-4 (8 Hrs)
Variable inductance and variable capacitance transducers: Inductive transducers, Principle of operation, construction details, characteristics and applications of LVDT, capacitive transducers, characteristics of capacitive transducers, Different types, Signal Conditioning, Applications, Capacitor microphone, Capacitive pressure sensor, Proximity sensor.

Unit-5 (8 Hrs)
Other transducers: Piezoelectric transducer, Hall Effect transducer, Magneto elastic sensor, Digital transducers, Fiber optic sensors, Thick & Thin Film sensors (Bio sensor & Chemical Sensor), Environmental Monitoring sensors (Water Quality & Air pollution), Introduction to Smart transducers and its applications.

Text/ Reference Books:

1. D. Patranabis, Sensors and Transducers, Prentice Hall of India.
2. Ian Sinclair, Sensors and Transducers, Elsevier.
3. Murthy, D.V.S., Transducers and Instrumentation, Prentice Hall of India.

OE-EC 802 Multimedia Communication

L-T-P-C
4-0-0-4

Course Outcomes: After completing this course the students will have the ability to:

1. Understand different types of media for information representation and Communication; representation of multimedia information in applications.
2. Interpret and process multimedia information as per requirement for society considering ethical issues.
3. Analyze and represent sound, speech, images, videos and also to store and communicate these efficiently.
4. Processing and transforming multimedia information as per requirement. Understanding and using standards for multimedia information.

Unit-1 (18 Hrs)

Multi-Dimensional Signals: Multi Dimensional signals-Finite Extent Signals and Periodic signals, Symmetric signals, special multi dimensional signals; Multi Dimensional Transforms-Fourier Transform, DFT, DCT;

Unit-2 (6 Hrs)

Multi Dimensional systems:-Impulse response and 2D convolution, Frequency response, FIR Filters and symmetry, IIR filters and partial difference equations, 2D sampling and reconstruction, Image digitization, Digital Image representation and storage, Pixels and its neighbors.

Unit-3 (9 Hrs)

Human Visual System and Color: Color Vision and Models, Contrast Sensitivity, Spatio-Temporal Frequency Response, Stereo/Depth Perception, Analog Video, Progressive vs. Interlaced Scanning, Analog-Video Signal Formats, Analog-to-Digital Conversion, Digital Video, Spatial Resolution and Frame Rate, Color, Dynamic Range, and Bit-Depth, Color Image Processing, Digital-Video Standards.

Unit-4 (10 Hrs)

Image Filtering: Image Smoothing, Linear Shift-Invariant Low-Pass Filtering; Image Enhancement, Pixel-Based Contrast Enhancement, Spatial Filtering for Tone Mapping and Image Sharpening, Image Denoising, Image and Noise Models, Linear Space-Invariant Filters in the DFT Domain, Local Adaptive Filtering, Nonlinear Filtering: Order-Statistics.

Unit-5 (9 Hrs)

Video Filtering: Theory of Spatio-Temporal Filtering, Frequency Spectrum of Video, Motion-Adaptive Filtering, Motion-Compensated Filtering, Video-Format Conversion, Down-Conversion, De-Interlacing, Frame-Rate Conversion, Multi-Frame Noise Filtering, Motion-Adaptive Noise Filtering, Motion-Compensated Noise Filtering.

Text/Reference Books:

1. R.C. Gonzalez and R.E. Woods, Digital Image Processing, 3rd Edition, Pearson Education, 2016.
2. Anil Kumar Jain, Fundamentals of Digital Image Processing, Pearson Education, 2015.

Power Plant Engineering (OE-ME 801)

L T P C

3 1 0 4

Prerequisite: Basic Knowledge of Thermodynamics and I C Engines.

Course outcomes (COs):

1. Understand the basics of power plants.
2. Analyze the working and layout of the of steam power plant.
3. Define the working principles of Diesel power plant, its layout, safety principles and compare it with other types of plants.
4. Discuss the working principle and basic components of the nuclear power plants and Hydro-electric power plants and safety precautions involved with it.
5. Discuss and analyze the mathematical and working principle of different electrical equipment involved in the generation of the power.

Course Contents:

Unit I

Introduction: Power and energy, sources of energy, review of thermodynamic cycles related to power plants, fuels and combustion calculations. Load estimation, load curves, various terms and factors involved in power plant calculations. Effect of variable load on power plant operation, Selection of power plant units.Power plant economics and selection.Effect of plant type on costs, rates, fixed elements, energy elements, customer elements and investor's profit; depreciation and replacement, theory of rates.Economics of plant selection, other considerations in plant selection.

Unit II

Steam power plant: General layout of steam power plant, Power plant boilers including critical and super critical boilers. Fluidized bed boilers, boilers mountings and accessories, Different systems such as coal handling system, pulverizes and coal burners, combustion system, draft, ash handling system, Dust collection system, Feed water treatment and condenser and cooling towers and cooling ponds, Turbine auxiliary systems such as governing, feed heating, reheating, flange heating and gland leakage. Operation and maintenance of steam power plant, heat balance and efficiency, Site selection of a steam power plant.

Unit III

Diesel power plant: General layout, Components of Diesel power plant, Performance of diesel power plant, fuel system, lubrication system, air intake and admission system, supercharging system, exhaust system, diesel plant operation and efficiency, heat balance, Site selection of diesel power plant, Comparative study of diesel power plant with steam power plant. Gas turbine power plant: Layout of gas turbine power plant, Elements of gas turbine power plants, Gas turbine fuels, cogeneration, auxiliary systems such as fuel, controls and lubrication, operation and maintenance, Combined cycle power plants, Site selection of gas turbine power plant, Integrated Gasifier based Combined Cycle (IGCC) systems.

Unit IV

Nuclear power plant: Layout and subsystems of nuclear power plants, Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANDU Reactor, Pressurized Heavy Water Reactor (PHWR), Fast Breeder Reactors (FBR), gas cooled and liquid metal cooled reactors, safety measures for nuclear power plants. Hydroelectric and Non-Conventional Power Plant: Hydroelectric power plants, classification, typical layout and components, principles of wind, tidal, solar PV and solar thermal, geothermal, biogas and fuel cell power systems.

Unit V

Electrical system: Generators and generator cooling, transformers and their cooling, bus bar, etc. Energy Saving and Control: Energy, economic and environmental issues, power tariffs, load distribution parameters, load curve, capital and operating cost of different power plants, pollution control technologies including waste disposal options for coal and nuclear plants.

Text Books:

1. Power Plant Engineering by P.K. Nag, Tata McGraw Hill.
2. Steam & Gas Turbines & Power Plant Engineering by R. Yadav, Central Pub. House.
3. Power Plant Engineering by Gupta, PHI India.

Reference Books:

1. Power Plant Engineering, by F.T. Morse, Affiliated East-West Press Pvt. Ltd.
2. Power Plant Engineering by Hedge, Pearson India.
3. Power Plant Technology, by Wakil, McGraw Hill.
4. Power Plant Engineering. Mahesh Verma, Metropolitan Book Company Pvt. Ltd.

Optimization Method in Engineering (OE-ME 802)

L T P C

3 1 0 4

Prerequisite: Course on calculus, matrix

Course Outcomes (COs):

After completion of the course a student will be able:

1. Learn one dimensional optimization methods.
2. Learn constrained optimization of multi-variable function.
3. Apply integer programming methods.
4. Dynamic programming and operation research problems
5. Learn soft computing based optimization.

Course Contents:

Unit I

Unconstrained Optimization: Optimizing Single-Variable Functions, Conditions for Local Minimum and Maximum, Optimizing Multi-Variable Functions.

Unit II

Constrained Optimization: Optimizing Multivariable Functions with Equality Constraint: Direct Search Method, Lagrange Multipliers Method, Constrained Multivariable Optimization with inequality constrained: Kuhn-Tucker Necessary conditions, Kuhn –Tucker Sufficient Conditions.

Unit III

Optimization: Quasi-Newton Methods and line search, least squares optimization, Gauss Newton, Extensions of LP to Mixed Integer Linear Programming (MILP), Non-Linar Programming, The Newton Algorithm, Non-Linear Least Squares, Sequential Quadratic Programming (SQP), Constrained Optimization, Multi-Objective Optimization, Branch and Bound Approaches.

Unit IV

Optimization in Operation Research: Dynamic Programming, Minimax and Maximax Algorithm, Discrete Simulation, Integer Programming – Cutting Plane Methods, Separable Programming, Goal Programming, Integer Linear Programming.

Unit V

Soft computing based optimization, Practical aspects of optimization.

Text books:

1. Engineering Optimization Theory and Practice by Rao S.S.
2. Methods of Optimization by Walsh G R.
3. Integer and Combinational Optimization by G.L.Nemhauser and L.A.Wolsey.
4. Operations Research: Applications and Algorithms by Winston W L

Reference books:

1. Model Building in Mathematics Programming by Williams H.P.
2. Integer and Combinational Optimization by G.L.Nemhauser and L.A.Wolsey
3. Discrete Optimization by R.G. Parker and R.L. Rardin.
4. Combinational Optimization: Algorithms and Complexity by C.H. Papadimitrious and K.Stegilite
5. Multi-objective evolutionary optimization for Product Design and Manufacturing by LihuiWang
6. Genetic Algorithms by Kalyanmoy Deb
7. Genetic Algorithms in search, optimization and machine learning by David E Goldberg, Pearson Springer.

Fracture Mechanics (OE-ME 803)

L T P C

3 1 0 4

Prerequisite: Basic Knowledge of Mechanics of Solids and Theory of Elasticity.

Course Outcomes (COs):

1. Basic Understanding of Crack in a Structure, Fracture Toughness, Types of Fracture.
2. Analyze elastic and elastic-plastic stress fields at the crack-tip in a solid material..
3. Estimate crack growth based on energy balance.
4. Demonstrate standard fracture mechanics tests for finding J-Integral and Crack Opening Displacement.
5. Inspect a solid material for the presence of crack.

Course Contents:

Unit I

Introduction: A Crack in a Structure, Fracture Toughness. Micro and Macro Phenomena of Fracture - Microscopic Aspects: Surface Energy, Theoretical Strength, Microstructure and Defects, Crack Formation - Macroscopic Aspects: Crack Growth, Types of Fracture, Mechanisms of Fracture and Crack Growth - Cleavage Fracture, Ductile Fracture, Fatigue Cracking, Environment Assisted Cracking, Creep Fracture, Service Failure Analysis

Unit II

Linear Elastic Stress Fields in Cracked Bodies • Introduction • Crack Deformation Modes and Basic Concepts, Westergaard Method, Singular Stress and Displacement Fields,Stress Intensity Factor Solutions,Three-Dimensional Cracks

Linear Elastic-Plastic Stress Fields in Cracked Bodies: Approximate Determination of the Crack-Tip Plastic Zone, Irwin's Model, Dugdale's Model

Unit III

Crack Growth Based on Energy Balance: Introduction, Energy Balance During Crack Growth, Griffith Theory, Graphical Representation of the Energy Balance Equation, Equivalence between Strain Energy Release Rate and Stress Intensity Factor, Compliance, Crack Stability.

Unit IV

Fracture Criteria: Critical Stress Intensity Factor Fracture Criterion, J-Integral and Crack Opening Displacement Fracture Criteria, Strain Energy Density Failure Criterion: Mixed-Mode Crack Growth.

Dynamic Fracture Introduction, Mott's Model , Stress Field around a Rapidly Propagating Crack , Strain Energy Release Rate, Crack Branching, Crack Arrest ,Experimental Determination of Crack Velocity and Dynamic Stress Intensity

Unit V

Introduction to Fatigue Fracture, Environment-Assisted Fracture, Creep Fracture and Crack Detection Methods such as Dye Penetration, Magnetic Particles, Eddy Current, Radiography, Ultrasonic, and Acoustic Emission**.**

Text Books:

1. Prashant Kumar, "Elements of Fracture Mechanics", Tata McGraw Hill Education Pvt. Ltd.
2. T.L. Anderson, "Fracture Mechanics - Fundamentals and Applications", CRC - Taylor and Francis.

Reference Books:

1. E.E. Gdoutos, "Fracture Mechanics - An Introduction", Springer.
2. D. Broek, "Elementary Engineering Fracture Mechanics", Kluwer Academic Publishers.
3. R.W. Hertzberg, "Deformation and Fracture Mechanics of Engineering Materials", Wiley India Pvt. Ltd.

Machine Tool Design (OE-ME 804)

L T P C

3 1 0 4

Prerequisite: Basic Knowledge of Workshop Technology.

Course Outcomes (COs):

After successful completion of this course students will be able to

1. Understand classification of machine tools with their nomenclature, specification and uses.
2. Explain working of various drives mounted in machine tools.
3. Analyze the speed and feed box with the regulation of speed and feed rates.
4. Design components like structural bed, column, power screws etc.
5. Apply knowledge to study dynamics of machine tool and its control.

Course Contents:

UNIT I

Introduction: Developments is machine tools, types of machine tools surface, profits and paths produced by machine tools. Features of construction and operations of basic machine tools e.g. lathe, drill, milling shapes and planers, grinding machine etc.General requirement of machine tool design.Machine tool design process. Tool wear, force Analysis.

UNIT II

Machine Tools Drives: Classification of machine tool drives, group Vs individual drives, Selection of electric motor, A brief review of the elements of mechanical transmission e.g. gear, belt and chain drives, Slider-crank mechanism, cam mechanism, nut & Screw transmission, Devices for intermittent motion, reversing & differential mechanisms. Couplings and clutches Elements of hydraulic transmission system. e.g. pumps, cylinder, directional control valves, pressure valves etc., Fundamentals of Kinematics structure of machine tools.

UNIT III

Regulation of Speed and Feed rates: Laws of stepped regulation, selection of range ratio, standardprogression ratio, selection of best possible structural diagram, speed chart, Design of feed box,developing gearing diagrams. stepless regulation of speed and feed in machine tool, speed and feedcontrol.

UNIT IV

Design of Machine Tool Structure: Requirements and design criteria for machine tool structures,selection of material Basic design procedure for machine tool structures, design of bed, column andhousing, Model technique in design.

Design of guide ways and power screws: Basic guide way profiles, designing guide way for stiffness a wear resistance, hydrostatic and antifriction grand ways. Design of sliding friction power Screws. Design of spindlier & spindle supports. Layout of bearings, selection of bearings for machine tools.

UNIT V

Dynamics of machine tools: General procedure for assessing the dynamic stability of cutting process,closed loop system, chatter in machine tools.

Control Systems: Functions, requirements & types of machine tool controls, controls for speed &feed change. Automatic and manual Controls.Basics of numerical controls.Machine tool testing.

Text Books:

1. N.K. Mehta, "Machine Tool Design and Numerical Control" Second Edition, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1984.
2. S.K. Basu and D.K. Pal, "Design of Machine Tools", Fourth Edition, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 1990.
3. G.C. Sen and A. Bhattacharya, "Principles of Machine Tools", Second Edition, New Central Book Agency (P) Ltd., Kolkata, 1988.

Reference Books:

1. F. Koenigsberger, "Design Principles of Metal Cutting and Machine Tools", Edition 1964, Pergamon Press Ltd., London.
2. H.C.Town, "The Design and Construction of Machine Tools", Central Machine Tool Research Institute, Bangalore, Machine Tool Design Handbook.
3. PSG College of Engg. & Technology, PSG Design Data Book.
4. N.K. Acherkan, "Machine Tool Design (Vol.I to Vol.IV)", Mir Publishers.

OE-CS 801	BLOCKCHAIN	3L-0T-0P	CREDIT -4

Course outcome expected:

By the end of the course the students should be able to:

CO1: To explore of blockchain and its architecture.
CO2: Understand the consensus, Consensus protocols for Permissioned Blockchains.
CO3: understand the Hyperledger Fabric and its implementation.
CO4: Applies blockchain concept in Financial Software and Systems, trade/supply chain (use cases).
CO5: Applies blockchain concept for Government(use case).

Unit-I Introduction :

Introduction to Blockchain: Digital Money to Distributed Ledgers , Design Primitives: Protocols, Security, Consensus, Permissions, Privacy. Blockchain Architecture and Design: Basic crypto primitives: Hash, Signature,) Hashchain to Blockchain, Basic consensus mechanisms

Unit-II : Consensus: Requirements for the consensus protocols, Proof of Work (PoW), Scalability aspects of Blockchain consensus protocols Permissioned Blockchains:Design goals, Consensus protocols for Permissioned Blockchains

Unit-III : Hyperledger Fabric (A): Decomposing the consensus process , Hyperledger fabric components, Chaincode Design and Implementation Hyperledger Fabric (B): Beyond Chaincode: fabric SDK and Front End (b) Hyperledger composer tool

Unit-IV: Use case 1 : Blockchain in Financial Software and Systems (FSS): (i) Settlements, (ii) KYC, (iii) Capital markets, (iv) Insurance Use case 2: Blockchain in trade/supply chain: (i) P Provenance of goods, visibility, trade/supply chain finance, invoice management discounting, etc

Unit-V Use case 3: Blockchain for Government: (i) Digital identity, land records and other kinds of record keeping between government entities, (ii) public distribution system social

Text Books:

1. Mstering Bitcoin: Unlocking Digital Cryptocurrencies, by Andreas Antonopoulos
2. Blockchain by Melanie Swa, O'Reilly
3. Hyperledger Fabric - https://www.hyperledger.org/projects/fabric
4. Zero to Blockchain - An IBM Redbooks course, by Bob Dill, David Smits - https://www.redbooks.ibm.com/Redbooks.nsf/RedbookAbstracts/crse0401.html

OE-CS 802	Computer Vision	3L-0T-0P	CREDIT -4

Course outcome expected:

By the end of the course the students should be able to:

CO1: To explore fundamental image processing techniques required for computer vision
CO2: Understand Image formation process and Generate 3D model from images.

CO3: Perform feature extraction and motion estimation on the images.

CO4: To perform shape analysis and perform segmentation.

CO5: Perform Object Analysis and do processing.

Unit-I Introduction :

Image Processing, Computer Vision and Computer Graphics , What is Computer Vision - Low-level, Mid-level, High-level , Overview of Diverse Computer Vision Applications: Document Image Analysis, Biometrics, Object Recognition, Tracking, Medical Image Analysis, Content-Based Image Retrieval, Video Data Processing, Multimedia, Virtual Reality and Augmented Reality.

Unit-II : Image Formation Models : Monocular imaging system , Radiosity: The 'Physics' of Image Formation, Radiance, Irradiance, BRDF, color etc, Orthographic & Perspective Projection,• Camera model and Camera calibration, Binocular imaging systems, Multiple views geometry, Structure determination, shape from shading , Photometric Stereo, Depth from Defocus , Construction of 3D model from images.

Unit-III :

Image Processing , Feature Extraction and Motion Estimation : Image preprocessing, Image representations (continuous and discrete) , Edge detection, Regularization theory , Optical computation , Stereo Vision , Motion estimation , Structure from motion

Unit-IV :

Shape Representation and Segmentation : Contour based representation, Region based representation, Deformable curves and surfaces , Snakes and active contours, Level set representations , Fourier and wavelet descriptors , Medial representations , Multiresolution analysis.

Unit-V

Object recognition and Image understanding: Hough transforms and other simple object recognition methods, Shape correspondence and shape matching, Principal component analysis , Shape priors for recognition, Pattern recognition methods, HMM, GMM and EM.

Text Books:

1. Computer Vision - A modern approach, by D. Forsyth and J. Ponce, Prentice Hall Robot Vision, by B. K. P. Horn, McGraw-Hill
2. Introductory Techniques for 3D Computer Vision, by E. Trucco and A. Verri, Publisher: Prentice Hall.
3. R. C. Gonzalez, R. E. Woods. Digital Image Processing. Addison Wesley Longman, Inc., 1992
4. D. H. Ballard, C. M. Brown. Computer Vision. Prentice-Hall, Englewood Cliffs, 1982.

OE-EE 801	Metro Systems and Engineering	L-T-P-C: 3-0-0-3
Course Outcomes: At the end of this course students will demonstrate the ability to		
CO1	Understand the basic plan of metro systems	
CO2	Aware of the construction methods, quality and safety systems	
CO3	Comprehend the SCADA based signalling system	
CO4	Understand vehicle dynamics, ventilation, fire safety	
CO5	Relate with the Power Supply and Back-up systems	

UNIT I GENERAL

Overview of Metro Systems; Need for Metros; Routing studies; Basic Planning and Financials

UNIT II CIVILENGINEERING

Overview and construction methods for: Elevated and underground Stations; Viaduct spans and bridges; Underground tunnels; Depots; Commercial and Service buildings. Initial Surveys & Investigations; Basics of Construction Planning & Management, Construction Quality & Safety Systems - Traffic integration, multimodal transfers and pedestrian facilities; Environmental and social safeguards; Track systems-permanent way. Facilities Management

UNIT III ELECTRONICS AND COMMUNICATION ENGINEERING

Signaling systems; Automatic fare collection; Operation Control Centre (OCC and BCC); SCADA and other control systems; Platform Screen Doors

UNIT IV MECHANICAL & TV + AC:

Rolling stock, vehicle dynamics and structure; Tunnel Ventilation systems; Air conditioning for stations and buildings; Fire control systems; Lifts and Escalators

UNIT V ELECTRICAL:

OHE, Traction Power; Substations- TSS and ASS; Power SCADA; Standby and Back-up systems; Green buildings, Carbon credits and clear air mechanics**.**

Reference Books:

1. Railway Engineering, Rangwala, Charotat Publishing
2. Civil Engineering for Underground Rail Transport, J.T. Edwards, Science Direct
3. **http://www.railsystem.net/electric-traction-systems/**

OE-EE 802	Speech and Audio Processing	L-T-P-C: 3-0-0-3
Course Outcomes: At the end of this course students will demonstrate the ability to		

CO1	Mathematically model the speech signal
CO2	Analyze the quality and properties of speech signal
CO3	Modify and enhance the speech and audio signals

UNIT I

Introduction- Speech production and modeling - Human Auditory System; General structure of speech coders; Classification of speech coding techniques – parametric, waveform and hybrid ; Requirements of speech codecs –quality, coding delays, robustness.

UNIT II

Speech Signal Processing- Pitch-period estimation, all-pole and all-zero filters, convolution; Power spectral density, periodogram, autoregressive model, autocorrelation estimation.

Linear Prediction of Speech- Basic concepts of linear prediction; Linear Prediction Analysis of non-stationary signals –prediction gain, examples; Levinson-Durbin algorithm; Long term and short-term linear prediction models; Moving average prediction.

UNIT III

Speech Quantization- Scalar quantization–uniform quantizer, optimum quantizer,logarithmicquantizer, adaptive quantizer, differential quantizers; Vector quantization – distortion measures, codebook design, codebook types.

Scalar Quantization of LPC- Spectral distortion measures, Quantization based onreflection coefficient and log area ratio, bit allocation; Line spectral frequency – LPC to LSF conversions, quantization based on LSF.

UNIT IV

Linear Prediction Coding- LPC model of speech production; Structures of LPCencoders and decoders; Voicing detection; Limitations of the LPC model.

UNIT V

Code Excited Linear Prediction-CELP speech production model; Analysis-by-synthesis; Generic CELP encoders and decoders; Excitation codebook search – state-save method, zero-input zero-state method; CELP based on adaptive codebook, Adaptive Codebook search; Low Delay CELP and algebraic CELP.

Speech Coding Standards-An overview of ITU-T G.726, G.728 and G.729standards

Text/Reference Books:

1. “Digital Speech” by A.M.Kondoz, Second Edition (Wiley Students‟ Edition), 2004.

2. “Speech Coding Algorithms: Foundation and Evolution of Standardized Coders”, W.C. Chu, WileyInter science, 2003.

Undergraduate Degree Courses in Engineering & Technology

BACHELOR OF ENGINEERING (COMPUTER SCIENCE & ENGINEERING)

General, Course structure & Theme
&
Semester-wise credit distribution

A. Definition of Credit:

1 Hr. Lecture (L) per week	1 credit
1 Hr. Tutorial (T) per week	1 credit
1 Hr. Practical (P) per week 2 Hours Practical (Lab)/week	0.5 credits 1 credit

B. Structure of Undergraduate Engineering program:

S. No.	Category	Suggested Breakup of Credits (Total 160)
1.	Basic Science Courses (BSC)	20
2.	Engineering Science Courses (ESC)	30
3.	Humanities, Social Science and Management Courses (HSMC)	10
4.	Professional Core Courses (PCC)	60
5.	Professional Elective Courses (PEC)	18
6.	Open Elective Courses (OEC)	14
7.	Seminar	2
8.	Project	10
9.	Internships in industry	8
10.	Mandatory Courses (MC)	NC
	Total Credits	172

C. Course code and definition:

Course code	**Definitions**
BSC	Basic Science Courses
ESC	Engineering Science Courses
HSMC	Humanities and Social Sciences including Management courses
PCC	Professional core courses
PEC	Professional Elective courses
OEC	Open Elective courses
LC	Laboratory course
MC	Mandatory courses

**Minor variation is allowed as per need of the respective disciplines.*

B.E II Year (Semester-III) Computer Science & Engineering
Course Structure & Evaluation Scheme

S.No.	Subject Category	Subject Code	Name of theSubject	Periods			EvaluationScheme				Subject Total	Credit
							Sessional			ESE		
				L	T	P	CT	TA	Total			
THEORYSUBJECT												
1	PCC	BCS301	Database Management System	3	0	0	30	10	40	60	100	3
2	PCC	BCS302	Data Structures	3	0	0	30	10	40	60	100	3
3	PCC	BCS303	Software Engineering	3	0	0	30	10	40	60	100	3
4	ESC	BEC301	Digital Electronics	3	1	0	30	10	40	60	100	4
5	BSC	BSC301	Mathematics-III	3	1	0	30	10	40	60	100	4
6	MC	MC302	Human values & Professional Ethics	2	0	0	30	10	40	60	100	0
PRACTICALS												
1	PCC	BCS352	Data Structure Lab	0	0	2	20	20	40	60	100	1
2	ESC	BEC351	Digital Electronics Lab	0	0	2	20	20	40	60	100	1
3	PCC	BCS351	Database Management System Lab	0	0	2	20	20	40	60	100	1
4	PROJECT	BCS353	Mini project/ Internship Assessment	0	0	-	-	-	100	-	100	2
			TOTAL	**17**	**2**	**6**			**460**	**540**	**1000**	**22**

Hours per week = 17 (L) +2 (T) +6(P) = 25 Hours

L-Lecture, P- Practical, CT-ClassTest, TA-Teacher'sAssessment, ESE-EndSemesterExamination

Dean (Academics) **Director**

B.E II Year (Semester-IV) Computer Science & Engineering
Course Structure & Evaluation Scheme

S. No.	Subject Category	Subject Code	Name of the Subject	Periods			Evaluation Scheme				Subject Total	Credit
				L	T	P	Sessional			ESE		
							CT	TA	Total			
THEORYSUBJECT												
1	PCC	BCS403	Design and Analysis of Algorithms	3	1	0	30	10	40	60	100	4
2	PCC	BCS401	Computer Organization	3	1	0	30	10	40	60	100	4
3	PCC	BCS402	OOPs using JAVA	3	1	0	30	10	40	60	100	4
4	PCC	BCS404	Discrete Mathematics	3	1	0	30	10	40	60	100	4
5	HSMC	BHSM401	Industrial Management	3	0	0	30	10	40	60	100	3
6	MC	MC401	Environment and Ecology	2	0	0	30	10	40	60	100	0
PRACTICALS												
1	PCC	BCS451	OOPs using java Lab	0	0	4	20	20	40	60	100	2
2	PCC	BCS452	Design and Analysis of Algorithms Lab	0	0	2	20	20	40	60	100	1
			TOTAL	**17**	**4**	**06**			**320**	**480**	**800**	**22**

Hours per week = 17 (L) +04 (T) +06 (P) = 27 Hours

L-Lecture, P- Practical, CT-ClassTest, TA-Teacher'sAssessment, ESE-EndSemesterExamination

Dean (Academics) **Director**

BCS-301	**Database Management System**	**3L-T-2P**	**CREDIT -4**

Unit 1: (8 Hours)

Introduction: An overview of database management system, database system Vs file system, Database system concept and architecture, data model schema and instances, data independence and database language and interfaces, data definitions language, DML, Overall Database Structure. Data Modeling using the Entity Relationship Model: ER model concepts, notation for ER diagram, mapping constraints, keys, Concepts of Super Key, candidate key, primary key, Generalization, aggregation, reduction of an ER diagrams to tables, extended ER model, relationship of higher degree.

Unit 2: (8 Hours)

Relational data Model and Language: Relational data model concepts, integrity 8 constraints, entity integrity, referential integrity, Keys constraints, Domain constraints, relational algebra, relational calculus, tuple and domain calculus. **Introduction on SQL:** Characteristics of SQL, advantage of SQL. SQl data type and literals. Types of SQL commands. SQL operators and their procedure. Tables, views and indexes. Queries and sub queries. Aggregate functions. Insert, update and delete operations, Joins, Unions, Intersection, Minus, Cursors, Triggers, Procedures in SQL/PL SQL

Unit 3: (8 Hours)

Data Base Design & Normalization: Functional dependencies, normal forms, first, second, 8 third normal forms, BCNF, inclusion dependence, loss less join decompositions, normalization using FD, MVD, and JDs, alternative approaches to database design.

Unit 4: (8 Hours)

Transaction Processing Concept: Transaction system, Testing of serializability, 8 serializability of schedules, conflict & view serializable schedule, recoverability, Recovery from transaction failures, log based recovery, checkpoints, deadlock handling. Distributed Database: distributed data storage, concurrency control, directory system

Unit 5: (8 Hours)

Concurrency Control Techniques: Concurrency control, Locking Techniques for 8 concurrency control, Time stamping protocols for concurrency control, validation-based protocol, multiple granularity, Multi version schemes **Database Failure and Recovery:** Database Failures, Recovery Schemes: Shadow Paging and Log-based Recovery, Recovery with Concurrent transactions.

Objectives of the course:

1. To understand the different issues involved in the design and implementation of a database system.
2. To study the physical and logical database designs, database modeling, relational,hierarchical, and network models
3. To understanduse data manipulation language to query, update, and manage a database.

4. To develop an understanding of essential DBMS concepts such as: database security,integrity, concurrency, distributed database, and intelligent database, Client/Server(Database Server), Data Warehousing.
5. To design and build a simple database system and demonstrate competence with the fundamental tasks involved with modeling, designing, and implementing a DBMS.

Suggested reference books:

1. "Database System Concepts", 6th Edition by Abraham Silberschatz, Henry F. Korth, S. Sudarshan, McGraw-Hill.
2. "Principles of Database and Knowledge – Base Systems", Vol 1 by J. D. Ullman, Computer Science Press.
3. "Fundamentals of Database Systems", 5th Edition by R. Elmasri and S. Navathe, Pearson Education.
4. " Foundations of Databases", Reprint by Serge Abiteboul, Richard Hull, Victor Vianu, Addison-Wesley

Course Outcomes:

1. For a given query write relational algebra expressions for that query and optimize the developed expressions
2. For a given specification of the requirement design the databases using E-R method and normalization.
3. For a given specification construct the SQL queries for Open source and Commercial DBMS - MYSQL, ORACLE, and DB2.
4. For a given query optimize its execution using Query optimization algorithms.
5. For a given transaction-processing system, determine the transaction atomicity, consistency, isolation, and durability.
6. Implement the isolation property, including locking, time stamping based on concurrency control and Serializability of scheduling.

BCS302	**Data Structure**	**3L-T-2P**	**CREDIT -3**

Unit 1 (7 Hours)
Introduction: Basic concepts and notations, Mathematical background, Revision of arrays and pointers, Recursion and implementation of Recursion,Time and Space Complexity, Asymptotic notations: Big Oh, Big Theta and Big Omega, Time-Space trade-off.
Searching: linear search and binary search techniques.

Unit 2 (9 Hours)
Stacks and Queues: Sequential representation of stacks and queues, Primitive Stack operations: Push & Pop, Application of stack: Prefix and Postfix Expressions, Evaluation of postfix expression, conversion of infix to postfix.
Lists: List representation techniques, Dynamics Storage allocation, Representation of stacks and queues using linked list, Operations on a Linked List: Insertion, Deletion, Traversal, Introduction to Doubly linked list, introduction to circularly linked list.

Unit 3 (6 Hours)
Sorting Algorithms and hashing: Insertion sort, Bubble sort, Quick sort, Merge sort, Heap sort, Shell sort, Time and Space complexity of sorting algorithms, hashing.

Unit 4 (7 Hours)
Trees: Definition and basic concepts, Linked tree **r**epresentations, Binary tree traversal algorithms, (Preorder, Inorder, Postorder), Binary search tree, Insertion and Deletion in Binary search tree, Multiway search trees, B trees, B+ tree and their applications.

Unit 5 (7 Hours)
Graphs: Introduction to Graphs, Data Structure for Graph Representations: Adjacency Matrices, Adjacency List, Graph Traversal: Depth First Search and Breadth First Search, Shortest Path algorithm: Warshal Algorithm and Dijikstra Algorithm.

Objectives of the course:

1. To impart the basic concepts of data structures and algorithms.
2. To understand concepts about searching and sorting techniques
3. To understand basic concepts about stacks, queues, lists, trees and graphs.
4. To enable them to write algorithms for solving problems with the help of fundamental data Structures

Suggested reference books:

1. Y. Langsam, M.J. Augenstein and A.M. Tenenbaum, Data Structure Using C and C++. Second Edition, Prentice Hall of India, 1997.
2. Seymour Lipschutz, Data Structures ,Schaum's Outlines, Tata McGraw Hill , New Delhi, 2006
3. Lafore – Data structure & Algorithms in java, (BPB Publication)
4. Sartaj Sahni – Data structure, Algorithms & application in C++ (McGraw Hill)

Course Outcomes:

1. To review the concepts of fundamental data structures to be used in programming. To understand various searching algorithms.
2. To understand the various operations on different types of data structures such as stacks, queues and linked lists. To apply and analyze various data structures on different applications.
3. To understand, analyze and compare various sorting algorithms. To understand the concept of hashing and its techniques.
4. To understand the various types of tree structures and their implementation. To evaluate various tree structures. To be able to apply tree structures on various problems.
5. To understand and implement various types of graphs**.** To study and implement various shortest path algorithms on graphs.

BCS303	**Software Engineering**	**3L-T-P**	**CREDIT -3**

Unit-1: (6Hours)
Introduction to Software Engineering, Software Components, Software Characteristics, Software Crisis, Software Engineering Processes, Similarity and Differences from Conventional Engineering Processes, Software Development Life Cycle (SDLC) Models: WaterFall Model, Prototype Model, Spiral Model, Evolutionary Development Models, Iterative Enhancement Models, Selection of Software Development Models.

Unit-2: (7Hours)
Software Requirement Specifications (SRS) Requirement Engineering Process: Elicitation, Analysis, Documentation, Review and Management of User Needs, Feasibility Study, Information Modeling, Data Flow Diagrams, Entity Relationship Diagrams, Decision Tables, SRS Document, IEEE Standards for SRS, Estimation of various Parameters such as Cost, Efforts, Schedule/Duration, Constructive Cost Models (COCOMO), Resource Allocation Models, Software Risk Analysis and Management.

Unit-3: (7Hours)
Software Design Basic Concept of Software Design, Architectural Design, Low Level Design: Modularization, Design Structure Charts, Pseudo Codes, Flow Charts, Coupling and Cohesion Measures, Design Strategies: Function Oriented Design, Object Oriented Design, Top-Down and Bottom-Up Design. Software Measurement and Metrics: Various Size Oriented Measures: Halestead‟s Software Science, Function Point (FP) Based Measures, Cyclomatic Complexity Measures: Control Flow Graphs.

Unit-4: (8Hours)
Software Testing Objectives, Unit Testing, Integration Testing, Acceptance Testing, Regression Testing, Testing for Functionality and Testing for Performance, Top-Down and Bottom-Up Testing Strategies: Test Drivers and Test Stubs, Structural Testing (White Box Testing), Functional Testing (Black Box Testing), Test Data Suit Preparation, Alpha and Beta Testing of Products. Static Testing Strategies: Formal Technical Reviews (Peer Reviews), Walk Through, Code Inspection, Compliance with Design and Coding Standards.

Unit-5: (7Hours)
Software Maintenance: Software as an Evolutionary Entity, Need for Maintenance, Categories of Maintenance: Preventive, Corrective and Perfective Maintenance, Cost of Maintenance, Software Re-Engineering, Reverse Engineering, Software Configuration Management Activities, Change Control Process, Software Version Control, Defect Detection and Removal: Defect Amplification Model, An Overview of CASE Tools.

Text and References Books:
1. R. S. Pressman, Software Engineering: A Practitioners Approach, McGraw Hill.
2. K. K. Aggarwal and Yogesh Singh, Software Engineering, New Age International Publishers.
3. Ian Sommerville, Software Engineering, Addison Wesley.
4. Pankaj Jalote, Software Engineering, Narosa Publication
5. Pfleeger, Software Engineering, Macmillan Publication.

BEC 301	**Digital Electronics**	**3L-1T-2P**	**CREDIT -4**

Unit 1: (7Hours)

Digital : Number Systems – Decimal, Binary, Octal, Hexadecimal, 1„s and 2„s complements, Codes – Binary, BCD, Excess 3, Gray, Alphanumeric codes, Boolean theorems, Logic gates, Universal gates, Sum of products and product of sums, Minterms and Maxterms, Karnaugh map Minimization and Quine-McCluskey method of minimization.

Unit 2: (8Hours)

Combinational Logic Design : Design Examples: Arithmetic Circuits, BCD - to – 7 segment decoder, Code converters. Adders and their use as subtractor, look ahead carry, Digital Comparator, Paritygenerators/checkers, Multiplexers and their use in combinational logic designs, multiplexer, De-multiplexers and their use in combinational logic designs, Decoders, demultiplexer.

Unit 3: (9Hours)

Sequential Logic Design:

1 Bit Memory Cell, Clocked SR, JK, MS J-K flip flop, D and T flip-flops. Use of preset and clear terminals, Excitation Table for flip flops.Conversion of flip flops. Application of Flip flops: Registers, Shift registers, Counters (ring counters,twisted ring counters), Sequence Generators, ripple counters,up/downcounters,synchronous counters, lock out, Clock Skew, Clock jitter. Effect on synchronous designs.Basic design steps- State diagram, State table, State reduction, State assignment, Mealy and Moore machines representation, Implementation, finite state machine implementation.

Unit 4: (8Hours)

Digital Logic Families:

Classification of logic families, Characteristics of digital ICs-Speed of operation, power dissipation, figure of merit, fan in, fan out, current and voltage parameters, noise immunity, operating temperatures and power supply requirements.TTL logic. Operation of TTL NAND gate, active pull up, wired AND, open collector output, unconnected inputs. Tri-State logic. CMOS logic – CMOS inverter, NAND, NOR gates, unconnected inputs, wired logic , open drain output. Interfacing CMOS and TTL.Comparison table of Characteristics of TTL, CMOS, ECL, RTL, I2L, DCTL.

Unit 5: (8Hours)

Programmable Logic Devices and Semiconductor Memories:

Programmable logic devices: Detail architecture, Study of PROM, PAL, PLA, Designing combinational circuits using PLDs. General Architecture of FPGA and CPLD Semiconductor memories: memory organization and operation, expanding memory size, Classification and characteristics of memories, RAM,ROM,EPROM, EEPROM, NVRAM, SRAM,DRAM.

Suggested reference books:

1. R.P. Jain, "Modern digital electronics", 3rd edition, 12th reprint Tata McGraw Hill Publication, 2007.
2. M. Morris Mano, "Digital Logic and Computer Design" 4th edition, Prentice Hall of India, 2013.
3. Anand Kumar, "Fundamentals of digital circuits" 1st edition, Prentice Hall of India, 2001
4. Tokheim, H. Roger L. "Digital Electronics Principles & Application"/ Tata McGraw-Hill / 6thEd.
5. NPTEL video lectures on Digital Circuits.

Objectives of the course:

At the end of this course, students will demonstrate the ability to

1. Understand working of logic families and logic gates.
2. Design and implement Combinational and Sequential logic circuits.
3. Understand the process of Analog to Digital conversion and Digital to Analog conversion.
4. Be able to use PLDs to implement the given logical problem.

MC 302	**Human values and Professional Ethics**	**2L-0T-0P**	**No CREDIT**

UNIT-1 (6 Hours)

Course Introduction - Need, Basic Guidelines, Content and Process for Value Education Understanding the need, basic guidelines, content and process for Value Education, Self-Exploration–what is it? - its content and process; 'Natural Acceptance' and Experiential Validation- as the mechanism for self-exploration, Continuous Happiness and Prosperity- A look at basic Human Aspirations, Right understanding, Relationship and Physical Facilities- the basic requirements for fulfilment of aspirations of every human being with their correct priority, Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario, Method to fulfill the above human aspirations.

UNIT-2 (6 Hours)

Understanding Harmony in the Human Being - Harmony in Myself Understanding human being as a co-existence of the sentient 'I' and the material 'Body', Understanding the needs of Self ('I') and 'Body' - Sukh and Suvidha, Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer), Understanding the characteristics and activities of 'I' and harmony in 'I', Understanding the harmony of I with the Body: Sanyam and Swasthya; correct appraisal of Physical needs, meaning of Prosperity in detail, Programs to ensure Sanyam and Swasthya.

UNIT-3 (7 Hours)

Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship Understanding harmony in the Family- the basic unit of human interaction, Understanding values in human-human relationship; meaning of Nyaya and program for its fulfillment to ensure Ubhay-tripti (Mutual Happiness); Trust (Vishwas) and Respect (Samman) as the foundational values of relationship, Understanding the meaning of Vishwas; Difference between intention and competence, Understanding the meaning of Samman, Difference between respect and disrespect; the other salient values in relationship, Understanding the harmony in the society (society being an extension of family): Samadhan, Samridhi, Abhay, Sah-astitva as comprehensive Human Goals, Visualizing a universal harmonious order in society.

UNIT-4 (6 Hours)

Understanding Harmony in the Nature and Existence - Whole existence as Co-existence Understanding the harmony in the Nature, Interconnectivity and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature, Understanding Existence as Co-existence (Sah-astitva) of mutually interacting units in all-pervasive space, Holistic perception of harmony at all levels of existence.

UNIT-5 (6 Hours)

Implications of the Holistic Understanding of Harmony on Professional Ethics Natural acceptance of human values, Definitiveness of Ethical Human Conduct, Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order, Competence in Professional Ethics: a) Ability to utilize the professional competence for augmenting universal human order, b) Ability to identify the scope and characteristics of people-friendly and eco friendly production systems, technologies and management models. Improving quality of work life at work place.

References Books:

1. A Nagraj, 1998, Jeevan Vidya EkParichay, Divya Path Sansthan, Amarkantak.
2. R. Subramanian,2017, Professional Ethics,
3. P L Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Publishers.
4. A N Tripathy, 2003, Human Values, New Age International Publishers.
5. SubhasPalekar, 2000, How to practice Natural Farming, Pracheen (Vaidik) KrishiTantraShodh, Amravati.
6. E G Seebauer& Robert L. Berry, 2000, Fundamentals of Ethics for Scientists &Engineers , Oxford University Press
7. M Govindrajran, S Natrajan& V.S. Senthil Kumar, Engineering Ethics (including Human Values), Eastern Economy Edition, Prentice Hall of India Ltd.
8. B P Banerjee, 2005, Foundations of Ethics and Management, Excel Books.
9. B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted

Course Objective

1. To help the students in distinguishing between values and skills, and understand the need, basic guidelines, content and process of value education.
2. To help the students initiate a process of dialog within themselves to know what they 'really want to be' in their life and profession
3. To help the students to understand the meaning of happiness and prosperity for a human being.
4. To facilitate the students to understand harmony at all the levels of human living, and live accordingly.
5. To facilitate the students in applying the understanding of harmony in existence in their profession and lead an ethical life

Course Outcome : On completion of this course, the students will be able to:

1. Understand the significance of value inputs in a classroom, distinguish between values and skills, understand the need, basic guidelines, content and process of value education, explore the meaning of happiness and prosperity and do a correct appraisal of the current scenario in the society
2. Distinguish between the Self and the Body, understand the meaning of Harmony in the Self the Co-existence of Self and Body.
3. Understand the value of harmonious relationship based on trust, respect and other naturally acceptable feelings in human-human relationships and explore their role in ensuring a harmonious society
4. Distinguish between ethical and unethical practices, and start working over the strategy to actualize a harmonious environment wherever they work.

BSC 301	**Mathematics-III**	**3L-1T-0P**	**CREDIT -4**

Unit – I: (7 Hours)
Fourier Transform :
Fourier integral, conditions of convergence, Fourier sine and cosine integrals, complex form, applications, Inversion formula for Fourier transform, operational properties. Discrete and Fast Fourier transform. Applications of Fourier transform to solve boundary value problems.

Unit- II: (8 Hours)
Functions of a Complex Variable and Conformal mapping:
Limit, Continuity, Differentiability and Analyticity of functions of a complex variable, Cauchy-Riemann equations, Harmonic functions, Complex functions as mappings, Linear Transformation, Inverse transformation, Bilinear Transformations, Conformal Mapping & applications.

Unit- III: (8Hours)
Integration of Complex Functions:
Contour integrals and evaluations, Cauchy's Theorem, Cauchy's Integral Formulae, Liouville's theorem, Convergence of power series, Taylor series, Laurent series, Zeros and Singularities of a complex function, Residues and Residue theorem, Evaluation of definite and improper integrals.

Unit- IV: (9 Hours)
Curve- Fitting& Probability:
Curve-fitting: method of least- squares, Normal equations, Normal equation in case of straight line, Fitting a straight line, Polynomial, non-linear and exponential curves, Change of origin.

Probability: Basics of probability, random variables, Expectation, Baye's theorem and probability distributions, Binomial, Poisson and Normal distributions.

Unit- V: (8 Hours)
Statistical Methods:
Sampling Theory, Parameters of Statistics, Tests of hypothesis and significance, z-test, t-test, $\chi 2$**-test ,**Goodness of fit test**,** Time series analysis, Index numbers, Quality control chart and acceptance sampling, Introduction to design of experiments, Forecasting models.

Books Recommended:

1. R.K. Jain & S.R.K. Iyengar; Advanced Engineering Mathematics, Narosa Publishing House, 2002.
2. ErwinKreyszig; Advanced Engineering Mathematics, John Wiley & Sons, 1962.
3. R.V. Churchill and J.L. Brown, Complex Variables and Applications, McGraw Hill, 1990.
4. B.S.Grewal, Higher Engineering Mathematics, Khanna Publisher, 2005.
5. J.H. Mathews and R.W. Howell, Complex analysis for Mathematics and Engineering, 3rd Ed. Narosa, 1998.

Course Outcomes:

Upon successful completion of this course, students will be able to:

1. Solve the Fourier Transform of function.
2. Compute poles & zeros.
3. Evaluate the real & complex integrals with the help of Cauchy's Residue Theorem.
4. Utilize curve fitting techniques for data representations and computation in engineering analysis.
5. Employee the principle of linear regression and correlation, translate real- world problems into probability models, use Binomial, Poisson & Normal Distribution to solve statistical problems.

Objectives of the course:

1. Fourier transform is useful in study of frequency response of filter, In the theories of communication engineering, wave propagation, transmission lines and solution of boundary value problems. Discrete and fast fourier transform are used in signal analysis.Fourier transform is also used in electromagnetic field, medical application and in error control coding. Discrete analysis playes an important role in the development of communication engineering.

2. Complex Analysis is the study of analytic functions. It is an elegant and powerful method useful in the study of heat flow, fluid dynamics and electrostatics. Two-dimensional potential problem can be solved using analytic functions.

3. The other important applications of this theory is to evaluate many real integrals which can not be evaluated by usual methods.

4. In many engineering problems to establish a linear, quadratic, cubic or exponential relationship between two quantities, it is required two or more unknowns in such a way that these follow whole data, such situations occur in the problems of curve fitting etc.

5. Correlation and regression are the most commonly used techniques for investigating the relationship between two quantitative variables. The theory of probability is the study of such random phenomenon, which are not deterministic. In analyzing and interpreting data that involves an element of "chance" or uncertainty, probability theory plays a vital role in the theory and application of statistics. Probability distribution is the theoretical counterpart of frequency distribution and plays an important role in the theoretical study of populations.

BCS 403	**Design and Analysis of Algorithms**	**3L-1T-4P**	**CREDIT -4**

Unit 1: (8 Hours)
Introduction: Review of elementary data structures, analyzing algorithms, asymptotic notation, recurrence relations, Hash tables, Binary search trees.

Unit 2: (9 Hours)
Sorting and Order Statistics: Heapsort, Priority queues, Quicksort, Merge sort, Sorting in linear time.
Advanced Design and Analysis Techniques: Dynamic programming – Elements, Matrix-chain multiplication, longest common subsequence, Travelling Salesperson problem, Greedy algorithms – Elements, activity-selection problem, Huffman codes, task scheduling problem, Knapsack Problem, Backtracking – Elements, 8 – Queens, Graph Coloring, Hamiltonian Cycles.

Unit 3: (7 Hours)
Advanced Data Structures: Operations in B-Trees, Binomial heaps, Fibonacci heaps, data structures for disjoint sets, strings.

Unit 4: (8 Hours)
Graph Algorithms: Review of graph algorithms, topological sort, strongly connected components, minimum spanning trees – Kruskal and Prim's, Single source shortest paths, relaxation, Dijkstra's algorithm, Bellman-Ford algorithm, single source shortest paths for directed acyclic graphs.

Unit 5: (8 Hours)
P – Hard & NP – Complete problems: Basic concepts, Clique Decision problem, Node Cover decision problem, Travelling Salesperson decision problem, Introduction to approximation algorithms Planer Graph Coloring, Maximum programs stored problem.

Suggested reference books:

1. Cormen, Leiserson and Rivest: Introduction to Algorithms, 2/e, PHI.
2. Horowitz, Sahni, and Rajasekaran: Fundamentals of Computer Algorithms, Second Edition, Universities Press, Hyderabad.
3. Aho, Hopcroft, and Ullman: The Design and Analysis of Computer Algorithms, Addison Wesley.

Course Outcomes:

1. Gain insight about design and analysis of standard searching and sorting algorithms. Learn various algorithm Analysis techniques.
2. Able to compare between different data structures i.e., trees, heaps etc. also, pick an appropriate data structure for a design situation.
3. Learn divide and conquer, Greedyparadigms and understand and analyze when an algorithmic design situation calls for them.
4. Developing and analyzing the solutions for the problems using Dynamic programming, backtracking and Branch and bound approaches..
5. Understand NP completeness and difference between NP-Hard & NP-complete problems..

Objectives of the course

1. Analyse the asymptotic performance of algorithms.
2. Write rigorous correctness proofs for algorithms.
3. Demonstrate a familiarity with major algorithms and data structures.
4. Apply important algorithmic design paradigms and methods of analysis.
5. Synthesize efficient algorithms in common engineering design situations.

BHSM 401	**Industrial Management**	**3L-0T-0P**	**CREDIT -3**

Unit I (6 Hours)

Introduction: Concept and scope of Industrial Management. Productivity: Definition, measurement, productivity index, types of production system, Industrial Ownership.

Unit II (7 Hours)

Functions of Management, Taylor's Scientific Management Theory, Fayol's Principles of Management, Social responsibilities of Management, Introduction to Human resources management: Nature of HRM, functions and importance of HRM.

Unit III (7 Hours)

Work Study: Introduction, definition, objectives, steps in work study, Method study: definition, objectives, steps of method study, Work Measurement: purpose, types of study — stop watch methods — steps — allowances — standard time calculations — work sampling, Production Planning and Control Inventory Control: Inventory, Cost, Models of inventory control: EOQ, ABC, VED

Unit IV (7 Hours)

Quality Control: statistical quality control, Control charts for variables and attributes, Acceptance Sampling- Single sampling- Double sampling plans, Introduction to TQM.

Unit V (7 Hours)

Project Management: Project network analysis, CPM, PERT and Project crashing and resource Leveling.

References:

1. Engineering Management (Industrial Engineering & Management)/ S.C. Sharma & T.R. Banga, Khanna Book Publishing Co. (P) Ltd., Delhi (ISBN: 978-93-86173-072)
2. Industrial Engineering and Management/ P. Khanna, Dhanpatrai publications Ltd.
3. Production & Operation Management /PaneerSelvam /PHI.
4. Industrial Engineering Management/NVS Raju/Cengage Learning.
5. Industrial Engineering Management I RaviShankar/ Galgotia.

BCS-401	**Computer Organization**	**3L-1T-0P**	**CREDIT -4**

Unit 1: **(7 Hours)**
Functional blocks of a computer: CPU, memory, input-output subsystems, control unit. Instruction set architecture of a CPU–registers, instruction execution cycle, RTL interpretation of instructions, addressing modes, instruction set. Case study – instruction sets of some common CPUs.

Unit 2: (8 Hours)
Data representation: signed number representation, fixed and floating point representations, character representation. Computer arithmetic – integer addition and subtraction, ripple carry adder, carry look-ahead adder, etc. multiplication – shift-and add, Booth multiplier, carry save multiplier, etc. Division restoring and non-restoring techniques, floating point arithmetic.

Unit 3: (9 Hours)
Introduction to x86 architecture**. CPU control unit design:** hardwired and micro-programmed design approaches, Case study – design of a simple hypothetical CPU. **Memory system design:** semiconductor memory technologies, memory organization. **Peripheral devices and their characteristics**: Input-output subsystems, I/O device interface, I/O transfers–program controlled, interrupt driven and DMA, privileged and non-privileged instructions, software interrupts and exceptions. Programs and processes–role of interrupts in process state transitions, I/O device interfaces – SCII, USB

Unit 4: (7 Hours)
Pipelining: Basic concepts of pipelining, throughput and speedup, pipeline hazards.
Parallel Processors: Introduction to parallel processors, Concurrent access to memory and cache coherency.

Unit 5: (7 Hours)
Memory organization: Memory interleaving, concept of hierarchical memory organization, cache memory, cache size vs. block size, mapping functions, replacement algorithms, write policies.

Suggested reference books:

1. "Computer Architecture and Organization", 3rd Edition by John P. Hayes, WCB/McGraw-Hill
2. "Computer Organization and Architecture: Designing for Performance", 10th Edition by William Stallings, Pearson Education.
3. "Computer System Design and Architecture", 2nd Edition by Vincent P. Heuring and Harry F. Jordan, Pearson Education.

Course outcomes:

1. Draw the functional block diagram of a single bus architecture of a computer and describe the function of the instruction execution cycle, RTL interpretation of instructions, addressing modes, instruction set.
2. Write assembly language program for specified microprocessor for computing 16 bit multiplication, division and I/O device interface (ADC, Control circuit, serial port communication).
3. Write a flowchart for Concurrent access to memory and cache coherency in Parallel Processors and describe the process.
4. Given a CPU organization and instruction, design a memory module and analyze its operation by interfacing with the CPU.
5. Given a CPU organization, assess its performance, and apply design techniques to enhance performance using pipelining, parallelism and RISC methodology.

Objectives of the course:

To expose the students to the following:

1. How Computer Systems work & the basic principles
2. Instruction Level Architecture and Instruction Execution
3. The current state of art in memory system design
4. How I/O devices are accessed and its principles.
5. To provide the knowledge on Instruction Level Parallelism
6. To impart the knowledge on micro programming
7. Concepts of advanced pipelining techniques.

BCS 402	**Object oriented programming using java**	**3L-1T-4P**	**CREDIT -4**

Unit 1: (8 Hours)

Introduction to Java : Basics of Java programming, Data types, Variables, Operators, Control structures including selection, Looping, Java methods, Overloading, Math class, Arrays in java.

Unit 2: (8 Hours)

Objects and Classes : Basics of objects and classes in java, Constructors, Finalizer, Visibility modifiers, Methods and objects, Inbuilt classes like String, Character, StringBuffer, File, this reference.

Unit 3: (7 Hours)

Inheritance and Polymorphism : Inheritance in java, Super and sub class, Overriding, Object class, Polymorphism, Dynamic binding, Generic programming, Casting objects, Instance of operator, Abstract class, Interface in java, Package in java, UTIL package.

Unit 4: (9 Hours)

Event and GUI programming : Event handling in java, Event types, Mouse and key events, GUI Basics, Panels, Frames, Layout Managers: Flow Layout, Border Layout, Grid Layout, GUI components like Buttons, Check Boxes, Radio Buttons, Labels, Text Fields, Text Areas, Combo Boxes, Lists, Scroll Bars, Sliders, Windows, Menus, Dialog Box, Applet and its life cycle, Introduction to swing.

Unit 5: (7 Hours)

Multithreading in Java and I/O programming : Text and Binary I/O, Binary I/O classes, Object I/O, Random Access Files. Thread life cycle and methods, Runnable interface, Thread synchronization, Exception handling with try-catch-finally, Collections in java, Introduction to JavaBeans and Network Programming.

Reference Books:

1 Introduction to Java Programming (Comprehensive Version), Daniel Liang, Seventh Edition, Pearson.
2 Programming in Java, Sachin Malhotra & Saurabh Chaudhary, Oxford University Press.
3 Murach's Beginning Java 2, Doug Lowe, Joel Murach and Andrea Steelman, SPD.
4 Core Java Volume-I Fundamentals, Eight Edition, Horstmann& Cornell, Pearson Education.
5 The Complete Reference, Java 2 (Fourth Edition), Herbert Schild, TMH.
6 Java Programming, D. S. Malik, Cengage Learning.

BCS403	Discrete Mathematics	3L-1T-0P	CREDIT -4

Unit-I: (8 Hours)
Set Theory, Relation & Function:
Sets,Operation on sets,Proof of some general identities on sets, Relations, Operation on Relation, Properties of Relations,Composite Relations, Recursive definition of Relation, Order of Relation, Closures of Relation, Equivalence Relation, Functions definition, Recursively defined function, Natural number Introduction, Mathematical Induction, Strong Induction.

Unit- II: (8 Hours)
Algebraic Structures:
Definition, Semi groups, Groups, Subgroups and order, Integer modulo m, cyclic group, Cosets,Lagrange's theorem, Normal subgroups, Permutation and Symmetric groups,Group Homomorphism, Isomorphism of Groups, Definition and elementary properties of Rings and Fields.

Unit –III: (7 Hours)
Propositional Logic:
Proposition, well formed formula, Truth tables,Tautology, Satisfiability, Contradiction, Validity, Logical operators, Logical Equivalence, De-Morgan's laws,Algebra of proposition, theory of Inference, Normal form, Connectivity NOR & NAND, Argument, theory of Argument, law of Duality, theory of Predicate logic,Quantifiers.

Unit –IV: (7 Hours)
Partially Ordered sets &Combinatories:
Partially ordered set, Hasse-diagram, Lattices (Definition and some properties). Introduction to combinatories, Counting techniques, Permutation & Combination, Practical problems on Permutation and Combination, Pigeon-Hole Principle, Recurrence Relation and their solutions, Generating Function.

Unit-V: (7 Hours)
Graphs:
Trees, Binary tree, Binary trees traversal, Binary search trees,Spanning trees, Kuruskal's algorithm for a shortest Spanning Tree,Travelling Salesman Problem, Graphs, Incedence, Degrees, Walks, Paths, Circuits, Characterization, Connectedness, Bipartite graphs, Planar graph, Euler & Hamiltonian graphs, Euler's formula, Kuratowski's two graphs, Utility problem.

Books Recommended:

1. C.L.Liu: Discrete Mathematics.
2. B.Kolman, R.C.Busby and S.C.Ross: Discrete Mathematical Structure, 5\e, Prentice Hall, 2004.
3. J.L.Mott, A.Kandel and T.P.Baker: Discrete Mathematical Structures for Computer Scientist & Mathematicians, Prentice-Hall India.
4. J.P.Trembley,R.Manohar: Discrete Mathematical Structures with applications to Computer Science, McGraw-Hill, Inc. New York, NY, 1975.
5. Swapan Kumar Sarkar: AText Book of Discrete Mathematics, S.Chand& Company Ltd., New Delhi.
6. J.P.Chauhan: Discrete Structures & Graph Theory, Krishna Prakashan Media (P) Ltd.

Course Objective :

1. Apply the operation of Sets and use Venn diagrams to solve applied problems; solve problems using the principle of inclusion-exclusion.Describe binary relations between two sets, Determine the domain and range of a discrete or non discrete function, graph functions, identify one to one function, perform the composition of functions, find inverse of a function, and apply the properties of functions to application problems.
2. This course aims to introduce students to two basic algebraic concepts, namely, groups, rings & fields. These concepts constitute an essential part of mathematical culture.
3. Simplify and evaluate basic logic statements including compound statements implications, inverses, converses, and contrapositives using truth tables and properties of logic. Express a logic sentence in terms of predicates, quantifiers, and logical connectives. Apply the rules of Inference, test for validity, and methods of proof including direct and indirect forms, proof by contradiction & proof by cases.
4. Solve counting problems by applying the elementary counting techniques using the sum and product rules, Permutations and Combinations, the Pigeon-hole principle, Identify the base step and or inductive step in applied problems, solve problems using recurrence relations & generating function.
5. Understand basic concepts about Trees and Graphs,represent a graph using an adjancy list and an adjancy matrix and apply graph theory to application problems. Determine if a graph is Euler or a Hamilton path or circuit. Use the properties of trees to classify trees, use binary search trees or decision trees solve problems.

Course Outcomes:

At the end of this course, students will be able to:

1. Understand the basic principles of sets and operation in sets. Demonstrate and understanding of relations and functions and be able to determine their properties. Determine when a function is 1-1 and "onto".
2. Use the theory, methods and techniques of the course to solve problems about groups, rings and fields.
3. Write an argument using logical notation and determine if the argument is or is not valid.
4. Apply counting principle to determine probabilities.
5. Demonstrate different traversal methods for trees and graphs.

MC-401	**Environmental &Ecology**	**2L-0T-0P**	**Non-Credit**

UNIT-I: (7 Hours)
Nature of Environment Introduction to Environmental Science - Definition and scope and need for public awareness Ecosystems Concept, structure and functions, restoration of damaged ecosystems Biodiversity – Definition, description at national and global level, threats and conservation Natural Resources - Renewable and non-renewable and their equitable use for sustainability, Material cycles – carbon, nitrogen and sulphur cycle. Conventional and Non-conventional Energy Sources – fossil fuel-based, hydroelectric, wind, -nuclear and solar energy, biomass, biodiesel, hydrogen as an alternative fuel

UNIT-II: (6 Hours)
Impact of Human Activity on Environment Human Population and Environment – Population growth, population explosion and migration; Impact of farming, housing, mining, transportation and industrial growth Social Issues Related to Environment– Sustainable development, urban problems (related to water and energy conservation and waste management), resettlement and rehabilitation Environmental ethics

UNIT-III: (7 Hours)
Environmental Changes and Human Health Environmental Pollution–Definition, causes and effects, control measures for water, air, soil, marine, land, noise, thermal pollution, Climate change– Greenhouse effect and global warming, acid rain, ozone layer formation and depletion Impact on human health – water and air borne diseases, diseases induced by residual impurities in drinking water (fluoride and arsenic); Toxic wastes and carcinogens; Nuclear hazards

UNIT- IV: (7 Hours)
Environmental Protection through Assessment and Education Indicators and Impact Assessment – Bio-indicators, Natural disasters and disaster management, Impact assessment through inventorying and monitoring Environmental Protection– Role of individuals, organizations and government in pollution control Laws, Conventions and Treaties–National legislation, issues in the enforcement of environmental legislation, initiatives by non- governmental organizations, global efforts in environmental protection Environmental education–women and value education Recommended

Textbook: Environmental Studies, J Krishnawamy , R J Ranjit Daniels, Wiley India. **Recommended Reference Books:**

1. Environmental Science, Bernard J. Nebel, Richard T. Right, 9780132854467, Prentice Hall Professional 1993.
2. Environment and Ecology, R K Khandal, 978-81-265-4277-2, Wiley India.
3. Environmental Science, 8th Ed ISV, Botkin and Keller, 9788126534142, Wiley India.
4. Environmental Studies, R Rajagopalan, 978-0195673937, Oxford University Press
5. Textbook of Environmental Science and Technology, M.Anjireddy, BS Publications
6. Environmental Studies, Soli. J Arceivala, Shyam, R Asolekar, 9781259006050, McGrawHill India, 2012.
7. Environmental Studies, D.L. Manjunath, 9788131709122 Pearson Education India, 2007
8. Textbook of Environment Ecology, Singh, Acme Learning
9. Perspective in Environmental Studies, Kaushik, New Age International
10. Environmental Studies, B. Joseph, 2nd Ed, 978-0070648134, Tata McGraw Hill

BCS-352	**Data structure lab**	**0L-0T-2P**	**1**

Write Program in C / C++ for following:

1. To implement stack using array.
2. To implement queue using array.
3. To implement circular queue using array.
4. To implement various operations on linked list:
   (a)insert (b)delete (c) display
5. To implement stack using linked list.
6. To implement queue using linked list.
7. To implement linear search.
8. To implement binary search.
9. To implement bubble sort.
10. To implement insertion sort.
11. To implement merge sort.
12. To implement quick sort.
13. Program to find the factorial of a number using recursion.
14. To implement Heap sort.
15. Implementation of graph menu driven program.

BEC 351	**Digital Electronics Lab**	**0L-0T-2P**	**1**

List of experiment:

1. To study about logic gate and verify their Truth table.
2. To design and implement half adder and full adder.
3. To design and implement half subtractor and full subtractor
4. To design and implement 8:1 MUX.
5. To design and implement 1:8 DEMUX.
6. To design and implement Encoder.
7. To design and implement Decoder.
8. To design and implement R-S flip flop and J K flip flop
9. To design and implement D& T flip flop
10. To design and implement Master -Slave flip flop
11. To design and implement SISO AND SIPO.
12. To design and implement PISO and PIPO
13. To design and implement DECAD counter.
14. To design and implement 4 bit shift register.
15. To convert Analog to Digital and Digital to Analog.

BCS 351	**Database Management System Lab**	**0L-0T-2P**	**1**

List of experiments:

Lab 1: Data Definition Language (DDL) commands in RDBMS

Lab 2: Data Manipulation Language (DML) and Data Control Language (DCL)

Lab 3: High level language extensions with cursors

Lab 4: High level language extension with Triggers

Lab 5: Procedures and Functions 8 6 Embedded SQL

Lab 6: Database design using E-R model and Normalization

Lab 7: Design and implementation of payroll processing system

Lab 8: Design and implementation of Banking system

Lab 9: Design and implementation of Library Information System

Lab 10: Design and implementation of Student Information System

Lab 11: Automatic Backup of Files and Recovery of Files

BCS 451	**Object Oriented programming using JAVA**	**0L-0T-4P**	**2**

List of experiments:

1.Program to define a structure of a basic JAVA program.

2 Program to define the data types, variable, operators, arrays and control structures.

3 Program to define class and constructors. Demonstrate constructors.

4 Program to define class, methods and objects. Demonstrate method overloading.

5 Program to define inheritance and show method overriding.

6 Program to demonstrate Packages.

7 Program to demonstrate Exception Handling.

8 Program to demonstrate Multithreading.

9 Program to demonstrate I/O operations.

10 Program to demonstrate Network Programming.

11 Program to demonstrate Applet structure and event handling.

12 Program to demonstrate Layout managers.

BCS452	**Design and Analysis of Algorithm**	**0L-0T-2P**	**1**

List of Experiments

1. To implement the following using array as data structure and analyse its time complexity
    a. Insertion sort
    b. Selection sort
    c. Bubble sort
    d. Quick sort
    e. Merge sort
    f. Bucket sort
    g. Shell sort
    h. Radix sort
    i. Heap sort
2. To implement Linear and Binary search and analyze its time complexity
3. To implement Matrix Chain Multiplication and analyze its time complexity
4. To implement Longest Common Subsequence problem and analyze its time complexity
5. To implement Optimal Binary Search Tree problem and analyze its time complexity
6. To implement Huffman coding and analyze its time complexity
7. To implement Dijkstra's algorithm and analyze its time complexity
8. To implement Bellman Ford algorithm and analyze its time complexity
9. To implement DFS and BFS and analyze their time complexities.
10. To implement following string matching algorithms and analyze time complexities:
    a. Naïve
    b. Rabin karp
    c. Knuth Morris Pratt

Table: Structure of B.E. Program

S. No.	Courses		Credits							Actual Credits
		Total Credits	I&II	III	IV	V	VI	VII	VIII	
1.	Basic Science Courses (BSC)	20	17	4						21
2.	Engineering Science Courses (ESC)	30	19	5			5			29
3.	Humanities, Social Science and Management Courses (HSMC)	10	4		3	3				10
4.	Professional Core Courses (PCC)	60		11	19	10	10	7	7	64
5.	Professional Elective Courses (PEC)	18				4	4	3	4	15
6.	Open Elective Courses (OEC)	14				3	3	4	4	14
7.	Seminar	2						2		2
8.	Project	10						3	7	10
9.	Internships in industry	8		2		2		3		7
10.	Mandatory Courses (MC)	NC								-
	Total Credits	172	40	22	22	22	22	22	22	172

B.E II Year (Semester-III) Computer Science & Engineering
Course Structure & Evaluation Scheme

S.No.	Subject Category	Subject Code	Name of theSubject	Periods			EvaluationScheme				Subject Total	Credit
				L	T	P	Sessional			ESE		
							CT	TA	Total			
	THEORYSUBJECT											
1	PCC	BCS303	Software Engineering	3	0	0	30	10	40	60	100	3
2	PCC	BCS302	Data Structures	3	0	0	30	10	40	60	100	3
3	ESC	BEC301	Digital Electronics	3	1	0	30	10	40	60	100	4
4	MC	MC302	Human values & Professional Ethics	2	0	0	30	10	40	60	100	0
5	BSC	BSC301	Mathematics-III	3	1	0	30	10	40	60	100	4
6	PCC	BCS301	Database Management System	3	0	0	30	10	40	60	100	3
	PRACTICALS											
1	PCC	BCS352	Data Structure Lab	0	0	2	20	20	40	60	100	1
2	ESC	BEC351	Digital Electronics Lab	0	0	2	20	20	40	60	100	1
3	PCC	BCS351	Database Management System Lab	0	0	2	20	20	40	60	100	1
4	PROJECT	BCS353	Mini project/ Internship Assessment	0	0	-	-	-	100	0	100	2
			TOTAL	**17**	**3**	**6**			**460**	**540**	**1000**	**22**

Hours per week = 17 (L) +3 (T) +6(P) = 26 Hours

L-Lecture, P- Practical, CT-ClassTest, TA-Teacher'sAssessment, ESE-EndSemesterExamination

B.E II Year (Semester-IV) Computer Science & Engineering
Course Structure & Evaluation Scheme

S. No.	Subject Category	Subject Code	Name of the Subject	Periods			Evaluation Scheme				Subject Total	Credit
				L	T	P	Sessional			ESE		
							CT	TA	Total			
	THEORYSUBJECT											
1	PCC	BCS403	Design and Analysis of Algorithms	3	1	0	30	10	40	60	100	4
2	PCC	BCS401	Computer Organization	3	1	0	30	10	40	60	100	4
3	PCC	BCS402	OOPs using JAVA	3	0	0	30	10	40	60	100	4
4	PCC	BCS404	Discrete Mathematics	3	1	0	30	10	40	60	100	4
5	HSMC	BHSM401	Industrial Management	3	0	0	30	10	40	60	100	3
6	MC	MC401	Environment and Ecology	2	0	0	30	10	40	60	100	0
	PRACTICALS											
1	PCC	BCS451	OOPs using java Lab	0	0	4	20	20	40	60	100	2
2	PCC	BCS452	Design and Analysis of Algorithms lab	0	0	2	20	20	40	60	100	1
			TOTAL	**17**	**3**	**06**			**360**	**540**	**900**	**22**

Hours per week = 17 (L) +03 (T) +06 (P) = 26 Hours

L-Lecture, P- Practical, CT-ClassTest, TA-Teacher'sAssessment, ESE-EndSemesterExamination

B.E III Year (Semester-V) Computer Science & Engineering
Course Structure & Evaluation Scheme

S. No.	Subject category	Subject Code	Name of the Subject	Periods			Evaluation Scheme				Subject Total	Credit
				L	T	P	Sessional Assessment			ESE		
							CT	TA	Total			
	THEORYSUBJECT											
1	PCC	BCS501	Computer Network	3	0	0	30	10	40	60	100	3
2	PCC	BCS504	Theory of Computation	3	0	0	30	10	40	60	100	3
3	PEC	DE-CS501-503	Departmental Elective-1	3	0	0	30	10	`40	60	100	3
4	OEC	OE-CS 501-503	**Open Elective I**	3	0	0	30	10	40	60	100	3
5	PCC	BCS503	Operating System	3	0	0	30	10	40	60	100	3
6	HSMC	BHSM501	Economics for Industry	3	0	0	30	10	40	60	100	3
	PRACTICALS											
1	PCC	PCC551	Operating System Lab	0	0	2	20	20	40	60	100	1
2	PEC	DE-CS501-503	Departmental Elective-1	0	0	2	20	20	`40	60	100	1
3	Internship	BCS552	Internship Assessment	0	0	-	-	-	100	-	100	2
			TOTAL	**18**	**0**	**6**			**420**	**480**	**900**	**22**

Hours per week = 18 (L) +0 (T) +06(P) = 24 Hours

B.E III Year (Semester-VI) Computer Science & Engineering
Course Structure & Evaluation Scheme

S. No.	Subjectcategory	Subject Code	Name of the Subject	Periods			Evaluation Scheme				Subject Total	Credit
				L	T	P	Sessional Assessment			ESE		
							CT	TA	Total			
		THEORYSUBJECT										
1	PCC	BCS602	Compiler Design	3	1	0	30	10	40	60	100	4
2	PCC	BCS601	Artificial Intelligence	3	1	0	30	10	40	60	100	4
3	ESC	BEC602	Microprocessor & microcontroller	3	0	0	30	10	40	60	100	4
4	OEC	OE-CS601-604	**Open Elective II**	3	0	0	30	10	40	60	100	3
5	PEC	DE-CS601-603	**Departmental Elective 2**	3	1	0	30	10	40	60	100	4
6	MC	MC601	Occupational Health and Safety	2	0	0	30	10	40	60	100	0
		PRACTICALS										
1	PCC	BCS652	Compiler Design	0	0	2	20	20	40	60	100	1
1	PCC	BCS651	Artificial Intelligence Lab	0	0	2	20	20	40	60	100	1
2	ESC	BEC651	Microprocessor & Microcontroller Lab	0	0	2	20	20	40	60	100	1.
			TOTAL	17	4	06			360	540	900	22

Hours per week = 17 (L) +04 (T) +06 (P) = 27Hours

B.E IV Year (Semester-VII) Computer Science & Engineering
Course Structure & Evaluation Scheme

S.No.	Subject category	Subject Code	Name of theSubject	Periods			EvaluationScheme				Subject Total	Credit
				L	T	P	Sessional Assessment			ESE		
							CT	TA	Total			
		THEORY										
1	PCC	BCS701	Soft Computing	3	0	0	30	10	40	60	100	3
2	OEC	OE-CS701-703	**Open Elective III**	3	0	0	30	10	40	60	100	4
3	PCC	BCS702	Digital Image Processing	3	1	0	30	10	40	60	100	3
4	PEC	DE-CS701-703	**Departmental Elective III**	3	0	0	30	10	40	60	100	3
		PRACTICAL										
1	PCC	BCS751	Soft Computing Lab	0	0	2	20	20	40	60	100	1
2	Internship	BCS753	Internships	0	0	-	20	20	40	60	100	3
3	seminar	BCS754	Seminar	0	0	2	20	20	40	60	100	2
4	Project	BCS752	Minor Project	0	0	6	-	-	100	-	100	3
			TOTAL	12	01	12			380	420	800	22

Hours per week = 12 (L) +1 (T) +12 (P) = 25 Hours

B.E IV Year (Semester-VIII) Computer Science & Engineering
Course Structure & Evaluation Scheme

S. No.	Subject Category	Subject Code	Name of theSubject	Periods			EvaluationScheme				Subject Total	Credit
				L	T	P	Sessional Assessment			ESE		
							CT	TA	Total			
		THEORYSUBJECT										
1	PCC	BCS801	Cryptography and Network Security	3	1	0	30	10	40	60	100	4
2	PEC	DE-CS801-803	**Departmental Elective-IV**	3	1	0	30	10	40	60	100	4
3	OEC	OECS801-803	**Open Elective IV**	3	0	0	30	10	40	60	100	4
4	PCC	BCS802	**Advance Database Management System**	3	0	0	30	10	40	60	100	3
		PRACTICALS										
1	PROJECT	BCS851	Major Project	0	0	14	-	-	150	150	300	7
			TOTAL	**12**	**2**	**16**	**140**	**60**	**350**	**450**	**800**	**22**

Hours per week = 12 (L) +2 (T) +16 (P) = 30Hours

List of open elective subject

Open elective (OE1) semester 5	
OE-CS 501	Operation research
OE-CS 502	Graph theory
OE-CS 503	Computer based numerical and statistical techniques
Open elective (OE1) semester 6	
OE-CS 601	Modeling and simulation
OE-CS 602	IOT
Open elective (OE 3) semester 7	
OE-CS 701	Data science
OE-CS 702	Big data analytic
Open elective (OE 4) Semester 8	
OE-CS 801	Block chain
OE-CS 802	Computer vision

List of departmental elective subject

Departmental elective (DE 1) Semester 5	
DE-CS 501	Data compression
DE-CS 502	Computer Graphics
DE-CS 503	Data Mining and warehousing
Departmental elective (DE 2) Semester 6	
DE-CS 601	Advance Computer Architecture
DE-CS 602	Mobile computing
DE-CS 603	Parallel and distributed computing
Departmental elective (DE 3) Semester 7	
DE-CS 701	Embedded system
DE-CS 702	Web Technology
DE-CS 703	Mobile application development
Departmental elective (DE 4) Semester 8	
DE-CS 801	Machine learning
DE-CS 802	Deep learning
DE-CS 803	Natural Language Processing

Computer Network

BCS501	**Computer Network**	**3L-T-P**	**CREDIT -3**

Course outcome expected:

By end of this course the student should be able to

CO1: To Study the basic taxonomy and terminology of the computer networking and enumerate the layers of OSI model and TCP/IP model. To understand the fundamentals and basics of Physical layer, and to apply them in real time applications.

CO2: to study and evaluate medium access layer protocols. To learn data link layer concepts, design issues, and protocols and to Demonstrate knowledge of various error detection, correction and flow control techniques in data link layer.

CO3: To classify the routing protocols, analyze how to assign the IP addresses for the given network and to evaluate different congestion control methods.

CO4: To understand, analyze and evaluate a number of Transport layer and presentation layer services, and protocols.

CO5: To understand the functions of Application layer paradigms and Protocols.

SYLLABUS

Unit -I

Introduction Concepts: Goals and Applications of Networks, Network structure and architecture, TCP/IP MODEL, The OSI reference model, services, Network Topology Design - Delay Analysis, Back Bone Design, Local Access Network Design.

Physical Level: Overview of data(analog & digital), signal(analog & digital), transmission (analog & digital) & transmission media (guided & unguided); Circuit switching: time division & space division switch

Unit-II

Medium Access sub layer: Medium Access sub layer – Channel Allocations, LAN protocols , Multiple access protocols: Pure ALOHA, Slotted ALOHA, CSMA, CSMA/CD, CSMA/CA.

Data Link Layer - Types of errors, framing(character and bit stuffing), error detection & correction methods; Flow control; Protocols: Stop & wait ARQ, Go-Back- N ARQ, Selective repeat ARQ.

Unit - III

Network Layer: Network Layer - Point - to Pont Networks, routing, Congestion control, Internetworking -TCP / IP - IP packet, IP address, IPv6. '

Unit – IV

Transport Layer: Transport Layer - Design issues, connection management, session Layer Design issues, remote procedure call. Presentation Layer-Design issues, Data compression techniques, cryptography - TCP – Window Management.

Unit-V

Application Layer: Application Layer: File Transfer, Access and Management, Electronic mail, Virtual Terminals, Other application, Example Networks - Internet and Public Networks.

Suggested reference books:

1. Forouzen, "Data Communication and Networking", TMH

2. A.S. Tanenbaum, “Computer Networks”, 3rd Edition, Prentice Hall India, 1997.

3. S. Keshav, “An Engineering Approach on Computer Networking”, Addison Wesley, 1997

4. W. Stallings, “Data and Computer Communication”, Macmillan Press

THEORY OF COMPUTATION

BCS502	**Theory of Computation**	**3L-T-P**	**CREDIT -3**

Course outcome expected:

By end of this course the student should be able to

CO1 To use basic concepts of formal languages of finite automata techniques

CO2 To Design Finite Automata's for different Regular Expressions and Languages

CO3 To Construct context free grammar for various languages

CO4. To solve various problems of applying normal form techniques, push down automata and Turing Machines

CO5.To understand the concept of recursively enumerable language.

SYLLABUS

Unit -I

FINITE AUTOMATA (FA): Introduction, Deterministic Finite Automata (DFA) -Formal definition, simpler notations (state transition diagram, transition table), language of a DFA. Nondeterministic Finite Automata (NFA)- Definition of NFA, language of an NFA, Equivalence of Deterministic and Nondeterministic Finite Automata, Applications of Finite Automata, Finite Automata with Epsilon Transitions, Eliminating Epsilon transitions, Minimization of Deterministic Finite Automata, Finite automata with output (Moore and Mealy machines) and Inter conversion.

UNIT - II

REGULAR EXPRESSIONS (RE): Introduction, Identities of Regular Expressions, Finite Automata and Regular Expressions- Converting from DFA's to Regular Expressions, Converting Regular Expressions to Automata, applications of Regular Expressions. REGULAR GRAMMARS: Definition, regular grammars and FA, FA for regular grammar, Regular grammar for FA. Proving languages to be non-regular -Pumping lemma, applications, Closure properties of regular languages.

UNIT - III

CONTEXT FREE GRAMMER (CFG): Derivation Trees, Sentential Forms, Rightmost and Leftmost derivations of Strings. Ambiguity in CFG's, Minimization of CFG's, CNF, GNF, Pumping Lemma for CFL's, Enumeration of Properties of CFL (Proof's omitted)

UNIT – IV

PUSHDOWN AUTOMATA: Definition, Model, Acceptance of CFL, Acceptance by Final State and Acceptance by Empty stack and its Equivalence, Equivalence of CFG and PDA.

TURING MACHINES (TM): Formal definition and behaviour, Languages of a TM, TM as accepters and TM as a computer of integer functions, Types of TMs.

UNIT V

RECURSIVE AND RECURSIVELY ENUMERABLE LANGUAGES (REL): Properties of recursive and recursively enumerable languages, Universal Turing machine, The Halting problem, Undecidable problems about TMs. Context sensitive language and linear bounded automata (LBA), Chomsky hierarchy, Decidability, Post's correspondence problem (PCP), undecidability of PCP.

TEXT BOOKS:

1.John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman (2007), Introduction to Automata Theory Languages and Computation, 3rdedition, Pearson Education, India.

REFERENCE BOOKS:

1. **1.** K. L. P Mishra, N. Chandrashekaran (2003), Theory of Computer Science-Automata Languages and Computation, 2nd edition, Prentice Hall of India, India.

OPERATING SYSTEM

BCS-503	**Operating System**	**3L-T-P**	**CREDIT -3**

Course outcome expected:

By end of this course the student should be able to

CO1: Analyze the structure of OS and basic architectural components involved in OS design

CO2: Analyze and design the applications to run in parallel either using process or thread models of different OS

CO3: Analyze the various device and resource management techniques for timesharing and distributed systems

CO4: Understand the Mutual exclusion, Deadlock detection and agreement protocols of Distributed operating system

CO5: Interpret the mechanisms adopted for file sharing in distributed Applications

CO6: Conceptualize the components involved in designing a contemporary OS

SYLLABUS

Unit I Introduction : Operating system and functions, Classification of Operating systems- Batch, Interactive, Time sharing, Real Time System, Multiprocessor Systems, Multiuser Systems, Multi process Systems, Multithreaded Systems, Operating System Structure- Layered structure, System Components, Operating System services, Reentrant Kernels, Monolithic and Microkernel Systems.

Unit – II Concurrent Processes: Process Concept, Principle of Concurrency, Producer / Consumer Problem, Mutual Exclusion, Critical Section Problem, Dekker's solution, Peterson's solution, Semaphores, Test and Set operation; Classical Problem in Concurrency- Dining Philosopher Problem, Sleeping Barber Problem; Inter Process Communication models and Schemes, Process generation.

Unit – III CPU Scheduling: Scheduling Concepts, Performance Criteria, Process States, Process Transition Diagram, Schedulers, Process Control Block (PCB), Process address space, Process identification information, Threads and their management, Scheduling Algorithms, Multiprocessor Scheduling. Deadlock: System model, Deadlock characterization, Prevention, Avoidance and detection, Recovery from deadlock.

Unit – IV Memory Management: Basic bare machine, Resident monitor, Multiprogramming with fixed partitions, Multiprogramming with variable partitions, Protection schemes, Paging, Segmentation, Paged segmentation, Virtual memory concepts, Demand paging, Performance of demand paging, Page replacement algorithms, Thrashing, Cache memory organization, Locality of reference.

Unit – V I/O Management and Disk Scheduling: I/O devices, and I/O subsystems, I/O buffering, Disk storage and disk scheduling, RAID. File System: File concept, File organization and access mechanism, File directories, and File sharing, File system implementation issues, File system protection and security.

References :

1. Silberschatz, Galvin and Gagne, "Operating Systems Concepts", Wiley
2. SibsankarHalder and Alex A Aravind, "Operating Systems", Pearson Education
3. Harvey M Dietel, " An Introduction to Operating System", Pearson Education
4. D M Dhamdhere, "Operating Systems : A Concept basedApproach", McGraw Hill.
5. Charles Crowley, "Operating Systems: A Design-Oriented Approach", Tata McGraw Hill Education".
6. Stuart E. Madnick & John J. Donovan, " Operating Systems", Tata McGraw Hill

OPERATING SYSTEM LAB

BCS-551	**Operating System lab**	**L-T-2P**	**CREDIT -1**

Course outcome expected:

By end of this course the student should be able to

CO1. Experiment with Unix commands and shell programming

CO2. Build 'C' program for process and file system management using system calls

CO3. Choose the best CPU scheduling algorithm for a given problem instance

CO4 . Identify the performance of various page replacement algorithms

CO5. Develop algorithm for deadlock avoidance, detection and file allocation strategies.

List of experiment

1. To implement CPU Scheduling Algorithms using c /c++ language
1.1FCFS
1.2 SJF
1.3SRTF
1.4 PRIORITY
1.5 ROUND ROBIN

2. Simulate all Page Replacement Algorithms.
2.1FIFO
2.2LRU
3. Simulate Paging Technique of Memory Management

ECONOMICS FOR INDUSTRY

BHSM501	**Economics for industry**	**3L-0T-0P**	**CREDIT -3**

Course outcome:

At the end of the course, the students will be able to

CO1. Define the main concepts and describe the models and methods in economic analysis

CO2. Explain economic events in individual markets and the aggregate economy using basic theory and tools

CO3. Apply supply and demand analysis to relevant economic issues

CO4. Explain how individual decisions and actions as a member of society affect the economy locally, nationally and internationally

CO5. Distinguish between perfect competition and imperfect competition and explain the welfare loss in non-competitive markets

SYLLABUS

Unit I: Introduction of Engineering Economics and Demand Analysis: Meaning and nature of Economics, Relation between science, engineering, technology and economics; Meaning of Demand, Determinants of Demand, Shifts in demand, Law of Demand, Price Elasticity of Demand &Types, Income Elasticity, Cross price Elasticity, Determinants of Elasticity, uses and importance of elasticity.

Unit II: Concept of Supply: Law of Supply, Factors affecting Supply, Elasticity of supply.
Demand Forecasting: Introduction, Meaning and Forecasting, Methods or Techniques of Demand Forecasting, Criteria for Good Demand Forecasting, Demand Forecasting for a New Product;

Unit III: Cost Analysis- Introduction, Types of Costs, Cost-Output Relationship: Cost Function, Cost-Output Relationships in the Short Run, and Cost-Output Relationships in the Long Run; Short run and long run, Break-Even Analysis; Production functions: laws of variable proportions, law of returns; Economies of scale: Internal and external.

Unit IV: Market Structure: Market Structure Perfect Competition, Imperfect competition – Monopolistic, Oligopoly, duopoly sorbent features of price determination and various market conditions.

Unit V: Nature and characteristics of Indian economy, concepts of LPG, elementary concepts of National Income, Inflation and Business Cycles ,Concept of N.I. and Measurement., Meaning of Inflation, Types and causes , Phases of business cycle .Investment decisions for boosting economy(National income and per capital income)

.Suggested reference books:

1. Premvir Kapoor, Sociology and Economics for Engineers, Khanna Publishing House (Edition 2018)
2. Salvatore D, “Principles of Microeconomics”, Oxford University Press.
3. Koutsoyiannis A, “Modern Microeconomic”, Macmillan Education Ltd.
4. Dwivedi DN, “Principles of Microeconomics”, Pearson Education.
5. Cowell, FA, “Microeconomic Principles and Analysis”, Oxford University Press.

BCS601	**Artificial Intelligence**	**3L-1T-P**	**CREDIT -4**

Course outcome expected:

By end of this course the student should be able to

CO1: To Demonstrate knowledge of the building blocks of AI as presented in terms of intelligent agents. Apply concept of Natural Language processing to problems leading to understanding of cognitive computing.

CO2: To Analyze and formalize the problem as a state space, graph, design heuristics and select amongst different search or game based techniques to solve them.

CO3: Develop intelligent algorithms for constraint satisfaction problems and also design intelligent systems for Game Playing.

CO4: To study and apply the basic issues of knowledge representation and Logic and blind and heuristic search, as well as an understanding of other topics such as chaining, resolution, etc. that play an important role in AI programs.

CO5: To understand various machine learning techniques and models.

SYLLABUS

UNIT I Introduction: Introduction to Artificial Intelligence, Foundations and History of Artificial Intelligence, Applications of Artificial Intelligence, Intelligent Agents, Structure of Intelligent Agents. Computer vision, Natural Language Possessing.

Unit II Introduction to Search : Searching for solutions, Uniformed search strategies, Informed search strategies, Local search algorithms and optimistic problems, Adversarial Search, Search for games, Alpha - Beta pruning

Unit III Knowledge Representation & Reasoning: Propositional logic, Theory of first order logic, Inference in First order logic, Forward & Backward chaining, Resolution, Probabilistic reasoning, Utility theory, Hidden Markov Models (HMM), Bayesian Networks.

Unit IV Machine Learning : Supervised and unsupervised learning, Decision trees, Statistical learning models, Learning with complete data - Naive Bayes models, Learning with hidden data - EM algorithm, Reinforcement learning,

Unit V Pattern Recognition : Introduction, Design principles of pattern recognition system, Statistical Pattern recognition, Parameter estimation methods - Principle Component Analysis (PCA) and Linear Discriminant Analysis (LDA), Classification Techniques – Nearest Neighbor (NN) Rule, Bayes Classifier, Support Vector Machine (SVM), K – means clustering.

Text books:

1. Stuart Russell, Peter Norvig, “Artificial Intelligence – A Modern Approach”, Pearson Education
2. Elaine Rich and Kevin Knight, “Artificial Intelligence”, McGraw-Hill
3. E Charniak and D McDermott, “Introduction to Artificial Intelligence”, Pearson Education
4. Dan W. Patterson, “Artificial Intelligence and Expert Systems”, Prentice Hall of India,

BEC-651	Artificial Intelligence Lab	L-T-2P	CREDIT-1

Course outcome expected:

By end of this course the student should be able to

CO1. To implements basic concepts of prolog.

CO2. To performs some mathematical concepts like factorial, Fibonacci using prolog.

CO3. To demonstrate various AI problems like water-jug, 4 queen's problem, etc

CO4. To implement search problems like A* algorithm.

List of experiments

1. Study of Prolog
2. Write simple fact for the statements using PROLOG.
3. Write a program to implement family tree.
4. Write a program to implement monkey banana problem using prolog.
5. To implement I/O in prolog.
6. Program to implement cut and fail operations.
7. To implement towers of Hanoi problem.
8. WAP to implement factorial, Fibonacci of a given number.
9. Write a program to implement water jug problem.
10. WAP to implement A* Algorithm using PROLOG.
11. Write a program to solve 4-Queen problem.

COMPILER DESIGN

BCS 602	**Compiler Design**	**3L-1T-P**	**CREDIT -4**

Course outcome expected:

By end of this course the student should be able to

CO1: Identify all essential steps for automatically converting source code into object code.(Understand)

CO2: Generate the low-level code for calling functions/methods in modern languages. (Apply)

CO3: Discuss opportunities for optimization introduced by naïve translation and approaches for achieving optimization such as instruction selection, instruction scheduling , register allocation, and peephole optimization.(Apply)

CO4: Interpret benefits and limitations of automatic memory management. (Understand)

CO5: Explain advantages, disadvantages and difficulties of just in time and dynamic recompilation. (Understand)

SYLLABUS

Unit 1 introduction to Compiler, Phases and passes, Bootstrapping, Finite 8 state machines and regular expressions and their applications to lexical analysis, Optimization of DFA-Based Pattern Matchers implementation of lexical analyzers, lexical-analyzer generator, LEX- compiler, Formal grammars and their application to syntax analysis, BNF notation, ambiguity, YACC. The syntactic specification of programming languages: Context free grammars, derivation and parse trees, capabilities of CFG.

Unit II Basic Parsing Techniques: Parsers, Shift reduce parsing, operator 8 precedence parsing, top down parsing, predictive parsers Automatic Construction of efficient Parsers: LR parsers, the canonical Collection of LR(0) items, constructing SLR parsing tables, constructing Canonical LR parsing tables, Constructing LALR parsing tables, using ambiguous grammars, an automatic parser generator, implementation of LR parsing tables.

Unit_III Syntax-directed Translation: Syntax-directed Translation schemes, 8 Implementation of Syntax-directed Translators, Intermediate code, postfix notation, Parse trees & syntax trees, three address code, quadruple & triples, translation of assignment statements, Boolean expressions, statements that alter the flow of control, postfix translation, translation with a top down parser. More about translation: Array references in arithmetic expressions, procedures call, declarations and case statements. IV Symbol Tables: Data structure for symbols tab

Unit – IV Symbol Tables: Data structure for symbols tables, representing scope 8 information. Run-Time Administration: Implementation of simple stack allocation scheme, storage allocation in block structured language. Error Detection & Recovery: Lexical Phase errors, syntactic phase errors semantic errors.

Unit –V Code Generation: Design Issues, the Target Language. Addresses 8 in the Target Code, Basic Blocks and Flow Graphs, Optimization of Basic Blocks, Code Generator. Code optimization: Machine-Independent Optimizations, Loop optimization, DAG representation of basic blocks, value numbers and algebraic laws, Global Data-Flow analysis.

Textbooks:

1. Aho, Sethi & Ullman, "Compilers: Principles, Techniques and Tools", Pearson Education

2. V Raghvan, " Principles of Compiler Design", TMH

3. Kenneth Louden," Compiler Construction", Cengage Learning.

4. Charles Fischer and Ricard LeBlanc," Crafting a Compiler with C", Pearson Education

Refrences:

1.K. Muneeswaran,Compiler Design,First Edition,Oxford University Press.

2.J.P. Bennet, "Introduction to Compiler Techniques", Second Edition, Tata McGraw-Hill,2003.

3.Henk Alblas and Albert Nymeyer, "Practice and Principles of Compiler Building with C", PHI, 2001.

COMPILER DESIGN LAB

BCS652	**Compiler Design Lab**	**0L-0T-2P**	**CREDIT -1**

Course outcome expected:

By end of this course the student should be able to

C01. By this laboratory, students will understand the practical approach of how a compiler works.

CO2. This will enable him to work in the development phase of new computer languages in industry.

C03 Student will learn is the Lexical Analyser's Basic Mechanism?

CO4 Generate machine code from the intermediate code forms

CO5 student will learn the ability to design and analyze a compiler

LIST OF EXPERIMENTS

1.Implementation of lexical analyzer for if statement and arithmetic expression

2.Construction of NFA from regular expression

3.Construction of DFA and NFA

4.Construction of recursive descent parser for the grammar

5.Write a c program to implement operator precedence parser

6.Implement to shift reduce parser algorithm

7.Design a code optimization for implementing constant propagation

8.write a program to perform loop unrolling for code optimization

9 .implementing code generator

MICROPROCESSOR AND MICROCONTROLLER

BEC-602	**Microprocessor & Microcontroller**	**3L-1T-0P**	**CREDIT-4**

Course outcome expected:

By end of this course the student should be able to

CO1. Recall and apply a basic concept of digital fundamentals to microprocessor based personal computer system and Recall the memory types and understand the interfacing of memory with microprocessor.

2. Understand the internal architecture and organization of 8085 & 8086.

CO2 .1. Apply knowledge and demonstrate programming proficiency using the various addressing modes and data transfer instructions of the target microprocessor and microcontroller.

2. Analyze assembly language programs; select appropriate assemble into machine a cross assembler utility of a microprocessor and microcontroller.

CO3. Discuss how the different peripherals are interfaced with microprocessor like 8255,8253/54,8237,8279,etc.

CO4. 1.To analyze the concepts of memory interfacing for faster execution of instructions and improves the speed of operations & hence performance of microprocessors.

2.To Understand the basic knowledge of advanced processor and Analyze the internal architecture of 80286,80486 and Pentium processor.

CO5 1. Analyze the internal architecture and real time control of 8051.

2. Analyze the internal architecture of ARM Processors.

SYLLABUS

Unit-I Introduction to Microprocessor:Evolution of Microprocessors, Register structure, ALU, Bus Organization, Timing and Control.
8-bit microprocessor: 8085 Microprocessor and its Architecture, Addressing Modes, The 8085 Programming Model, Instruction Classification, Instruction Format, Overview of Instruction set- Data Transfer Operation, Arithmetic Operation, Logic Operation and Branch Operation; Introduction to Assembly language program., Assembler Directives, Parameter passing and recursive procedures.

Unit-II Programming Technique With Additional Instruction: Looping, Counting, Indexing, Additional data Transfer and 16 bit Arithmetic instruction, Counters and time delays, Stack and Subroutine.
16 bit Microprocessor: Architecture of 8086- Register Organization, Execution unit, Bus Interface Unit, Signal Description, Physical Memory Organization, Mode of Operation, I/O Addressing Capabilities.Features of Numeric processor 8087,Floating point representation, range resolution, normalization, representation of zero, unused codes, parity bit and error detection.

Unit- III Basic of Interfacing:Programmed I/O, Interrupt driven I/O, DMA(8257), Parallel I/O (8255-PPI), Serial I/O(8251/8250, RS-232 standard)8259Programmable Interrupt Controller, 8237-DMA Controller, 8253/8254 Programmable Timer/Counter,(8279) Keyboard and display interface, ADC and DAC interfacing

Unit-IV Memory Interfacing: Types of memory, RAM and ROM , Concepts of virtual memory, Cache memory. Advanced coprocessor Architecture-286,486, Pentium

Unit-VAn Introduction to Microcontroller 8051 : The 8051 Architecture, Instructionset,Basic Assembly language programming concept.**Introduction to Risc Processor:** ARM microcontrollers Interface design.

Textooks:

1. Douglas V.Hall/8086 Microprocessors Architecture
2. R.S. Gaonker/Microprocessor Architecture: Programming and Applications with the 8085/8080A/ PenramInterational Publishing,1996.
3. Kenneth J.Ayala/The 8051 Microcontroller/Penram International Publishing.
4. Liu Gibson/Microprocessor
5. Ray, A.K. &Burchandi, K.M./ "Advanced Microprocessors and Peripherals: Architecture, Programming and Interfacing"/ Tata McGraw Hill.
6. Brey, Barry B. / "INTEL microprocessors" / Prentice Hall (India) /4th Ed.

MICROPROCESSOR AND MICROCONTROLLER

BEC-651	**Microprocessor & Microcontroller lab**	**0L-0T-2P**	**CREDIT-1**

Course outcome expected:

By end of this course the student should be able to

CO1. Do basic assembly language programming of 8085.

CO2. Do advance assembly language programming of 8086.

CO3. Do basic assembly language programming of 8085 for interfacing of peripherals.

CO4. Do advance assembly language programming of 8086 for interfacing of peripherals.

List of Experiments

1. Signed and Unsigned binary addition.
2. Signed Multiplication.
3. Signed and Unsigned binary division
4. BCD addition and subtraction.
5. Ascending and Descending.
6. BCD and binary conversion
7. Binary to BCD conversion
8. Programs for 16 bit arithmetic operations for 8086
9. Program for sorting an array for 8086
10. Program for searching for a number or character in a string for 8086
11. Interfacing with seven segment display
12. Interfacing with 8255 in I/O mode and BSR mode
13. Interfacing with 8253
14. Interfacing with ADC/DAC
15. Look up table method for finding the ASCII of an alpha numeric code.
16. Programming using arithmetic, logical and bit manipulation instructions of 8051
17. Program and verify Timer/Counter in 8051.
18. Program and verify interrupt handling in 8051.
19. UART operation in 8051.
20. Interfacing LCD to 8051.
21. Interfacing matrix or keyboard to 80

OCCUPATIONAL HEALTH AND SAFETY

MC601	**Occupational Health and Safety**	**2L-0T-P**	**NO CREDIT**

Course outcome expected:

By end of this course the student should be able to

CO1 Identify the diseases associated with occupation.

CO2 Manage safety in industries by suggesting safety measures.

CO3 Identify the accidental causes & apply the preventions.

CO4 Identify Fire Explosion & apply PPE.

CO5 Identify & apply Hazards & Risk identification, Assessment and control techniques.

SYLLABUS

Unit I Occupational Health: Classification of occupational health hazards, dangerous properties of chemical and their health effects, routes of entry of toxic material into human body, permissible exposure limits, Threshold limit value, lethal dose and lethal concentration, Ergonomics, constituents of ergonomics, application of ergonomics for safety & health, occupational diseases due to metals & dusts, fumes & chemical compounds.

Unit II Safety : Concept, Philosophy & Psychology of safety: Concept of safety, Nature of concept of safety, Philosophy of safety, safety terminology, philosophy of total safety concept, safety psychology, accident causative factors, general psychological factors

Unit III Accident Causes and prevention: Causation, Accident problem, Reasons for prevention, factors impending safety, Accident prevention **Safety Management:**Concept of management, element of management, functions, management principles, safety management & its responsibilities, safety Organization **Electrical Safety:**Electricity and Hazardous, Indian standards, effects of electrical parameters on human body, safety measures for electric works

Unit IV Fire and Explosion: Fire phenomena, classification of fire and extinguishers, statutory and other standards, fire prevention & protection system, explosion phenomena, explosion control devices, fire awareness signs

Personal Protective Equipment: Need of PPE, Indian standards, factors of selection of PPE, non respiratory equipments, respiratory equipments.

Unit V Hazards & Risk identification, Assessment and control techniques: Hazards, Risks & detection techniques, Preliminary hazard analysis(PHA) & hazard analysis(HAZAN), failure mode effect analysis(FMEA), Hazard and operability(HAZOP) study, Hazard ranking (DOW & MOND index), Fault tree analysis, Event tree analysis(ETA), major accident hazard control, on-site and off-site emergency plans. Safety in different industries as case study

Soft Computing

BCS701	Soft Computing	**3L-0T-0P**	**CREDIT -3**

Course outcome expected:

By the end of the course the students should be able to:

CO1: To understand the fundamental theory and concepts of neural networks, Identify different neural network architectures, algorithms, applications and their limitations. Understand appropriate learning rules for each of the architectures and learn several neural network paradigms and its applications
CO2: Apply perceptron and backprogation technique for classification.
CO3: Understand the concepts of crisp fuzzy sets.
CO4: knowledge representation using fuzzy rules, approximate reasoning, fuzzy inference systems, and fuzzy logic and apply fuzzification and defuzzinfication.
CO5: Analyze the genetic algorithms and their applications. Apply genetic algorithms to combinatorial optimization problems

SYLLABUS

Unit-I : Neural Networks-1(Introduction & Architecture) Neuron, Nerve structure and synapse, Artificial Neuron and its model, activation functions, Neural network architecture: single layer and multilayer feed forward networks, recurrent networks.Various learning techniques; perception and convergence rule, Auto-associative and hetro-associative memory.
Unit-II : Neural Networks-II (Back propogation networks) Architecture: perceptron model, solution, single layer artificial neural network, multilayer perception model; back propogation learning methods, effect of learning rule co-efficient ;back propagation algorithm, factors affecting backpropagation training, applications.

Unit-III : Fuzzy Logic-I (Introduction) Basic concepts of fuzzy logic, Fuzzy sets and Crisp sets, Fuzzy set theory and operations, Properties of fuzzy sets, Fuzzy and Crisp relations, Fuzzy to Crisp conversion.

Unit-IV : Fuzzy Logic –II (Fuzzy Membership, Rules) Membership functions, interference in fuzzy logic, fuzzy if-then rules, Fuzzy implications and Fuzzy algorithms, Fuzzyfications & Defuzzificataions, Fuzzy Controller, Industrial applications.

Unit-V : Genetic Algorithm(GA) Basic concepts, working principle, procedures of GA, flow chart of GA, Genetic representations, (encoding) Initialization and selection, Genetic operators, Mutation, Generational Cycle, applications.

Text Books:

1. S. Rajsekaran & G.A. Vijayalakshmi Pai, “Neural Networks,Fuzzy Logic and Genetic Algorithm:Synthesis and Applications” Prentice Hall of India.
2. N.P.Padhy,”Artificial Intelligence and Intelligent Systems” Oxford University Press

Reference Books:

1. Siman Haykin,”Neural Netowrks”Prentice Hall of India
2. Timothy J. Ross, “Fuzzy Logic with Engineering Applications” Wiley India.
3. Kumar Satish, “Neural Networks” Tata Mc Graw Hill

Soft Computing Lab

BCS751	Soft Computing LAB	**0L-0T-2P**	**CREDIT -1**

Course outcome expected:

By the end of the course the students should be able to:

CO1: Learn McCulloch-pits

CO2: Execute Hebb's Net and Perceptron Training Algorithm

CO3: Learn and execute logic gates and Genetic Algorithm

List Of Experiments

1. Write A Program For Implementing Linear Saturating Function.
2. Generate ANDNOT function using McCulloch-Pitts neural net.
3. Generate XOR function using McCulloch-Pitts neural net.
4. Write A Program To Implement Hebb's Net to classify two dimensional input patterns in bipolar with given targets.
5. Perceptron net for an AND function with bipolar inputs and targets.
6. Write A Program Of Perceptron Training Algorithm.
7. Write A Program For Back Propagation Algorithm .
8. Write A Program To Implement Logic Gates.
9. To perform Union, Intersection and Complement operations.
10. To plot various membership functions.
11. Implement fuzzy relation by Cartesian product of any two fuzzy sets and perform max-min composition on any two fuzzy relations.
12. Study and Analysis Of Genetic Algorithm Life Cycle.
13. To implement Genetic Algorithm.
14. Implement travelling sales person problem (tsp) using genetic algorithms.

REFERENCE BOOKS :

1. S.N. Shivnandam, "Principle of soft computing", Wiley.

2. S. Rajshekaran and G.A.V. Pai, "Neural Network , Fuzzy logic And Genetic Algorithm", PHI.

3. Jack M. Zurada, "Introduction to Artificial Neural Network System" JAico Publication.

4. Simon Haykins, "Neural Network- A Comprehensive Foudation"

Digital Image Processing

BCS702	Digital Image Processing	**3L-1T-P**	**CREDIT -4**

Course Outcomes Expected:

By the end of the course the students should be able to:

CO1: Review the fundamental concepts of a digital image processing system.

CO2 : Analyze images in the frequency domain using various transforms.

CO3 : Evaluate the techniques for image enhancement and image restoration.

CO4 : Categorize various compression techniques.

CO5: Interpret Image compression standards.

CO6 : Interpret image segmentation and representation techniques.

SYLLABUS

UNIT-I

Introduction and Fundamentals Motivation and Perspective, Applications, Components of Image Processing System, Element of Visual Perception, A Simple Image Model, Sampling and Quantization.

UNIT-II

IMAGE ENHANCEMENT : Spatial Domain: Gray level transformations – Histogram processing – Basics of Spatial Filtering– Smoothing and Sharpening Spatial Filtering, Frequency Domain: Introduction to Fourier

Transform– Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters, Homomorphic filtering, Color image enhancement Sharpening – The Laplacian

UNIT-III

Image Restoration Image Enhancement in Spatial Domain

Introduction; Basic Gray Level Functions – Piecewise-Linear Transformation Functions: Contrast Stretching; Histogram Specification; Histogram Equalization; Local Enhancement; Enhancement using Arithmetic/Logic Operations – Image Subtraction,Image Averaging; Basics of Spatial Filtering; A Model of Restoration Process, Noise Models, Restoration in the presence of Noise only-Spatial Filtering – Mean Filters: Arithmetic Mean filter, Geometric Mean Filter, Order Statistic Filters – Median Filter, Max and Min filters; Periodic Noise Reduction by Frequency Domain Filtering – Bandpass Filters; Minimum Mean-square Error Restoration.

UNIT-IV

Morphological Image Processing

Introduction, Logic Operations involving Binary Images, Dilation and Erosion, Opening and Closing, Morphological Algorithms – Boundary Extraction, Region Filling, Extraction of Connected Components, Convex Hull, Thinning, Thickening

UNIT-V

Registration Introduction, Geometric Transformation – Plane to Plane transformation, Mapping, Stereo Imaging – Algorithms to Establish Correspondence, Algorithms to Recover Depth

Segmentation Introduction, Region Extraction, Pixel-Based Approach, Multi-level Thresholding, Local Thresholding, Region-based Approach, Edge and Line Detection: Edge Detection, Edge Operators, Pattern Fitting Approach, Edge Linking and Edge Following, Edge Elements Extraction by Thresholding, Edge Detector Performance, Line Detection, Corner Detection.

TOTAL: 45 PERIODS

REFERENCES:

1. Digital Image Processing 2nd Edition, Rafael C. Gonzalvez and Richard E. Woods. Published by:

Pearson Education.

2. Digital Image Processing and Computer Vision, R.J. Schalkoff. Published by: John Wiley and

Sons, NY.

3. Fundamentals of Digital Image Processing, A.K. Jain. Published by Prentice Hall, Upper Saddle

River, NJ.

4. Sonka, Digital Image Processing and Computer Vision, Cengage Learning

5. Gonzalez and Woods, Digital Image Processing, Addison Wesley.

Cryptography and Network Security

BCS801	**Cryptography and Network Security**	**3L-1T-0P**	**CREDIT -4**

Course Outcomes

By the end of the course the students should be able to:

CO1 Illustrate the concepts of Network Security and Compare Various Symmetric and Asymmetric Cryptographic methods used for Network Security.

CO2 Classify various Algorithms to be used at various TCP/IP Layers & to operate Digital Signature in Real World Situation

CO3 Summarize different Authentication Techniques & Describe programs like PGP & S/MIME

CO4 Implement IP Security Architecture &Transport Layer Security to identify the vulnerability of the Internet systems and recognize the mechanisms of the attacks, and apply them to design and evaluate counter-measure tools

CO5 Implement Firewall design principles and identify various intrusion detection systems and be able to achieve highest system security

Syllabus

Unit-I Introduction to security attacks, services and mechanism, introduction to cryptography. Conventional Encryption: Conventional encryption model, classical encryption techniques- substitution ciphers and transposition ciphers, cryptanalysis, stereography, stream and block ciphers. Modern Block Ciphers: Block ciphers principals, Shannon's theory of confusion and diffusion, fiestal structure, data encryption standard(DES), strength of DES, differential and linear crypt analysis of DES, block cipher modes of operations, triple DES, IDEA encryption and decryption, strength of IDEA, confidentiality using conventional encryption, traffic confidentiality, key distribution, random number generation.

Unit-II Introduction to graph, ring and field, prime and relative prime numbers, modular arithmetic, Fermat's and Euler's theorem, primality testing, Euclid's Algorithm, Chinese Remainder theorem, discrete logarithms. Principals of public key crypto systems, RSA algorithm, security of RSA, key management, Diffle-Hellman key exchange algorithm, introductory idea of Elliptic curve cryptography, Elganel encryption.

Unit-III Message Authentication and Hash Function: Authentication requirements, authentication functions, message authentication code, hash functions, birthday attacks, security of hash functions and MACS, MD5 message digest algorithm, Secure hash algorithm(SHA). Digital Signatures: Digital Signatures, authentication protocols, digital signature standards (DSS), proof of digital signature algorithm.

Unit-IV Authentication Applications: Kerberos and X.509, directory authentication service, electronic mail security-pretty good privacy (PGP), S/MIME.

Unit-V IP Security: Architecture, Authentication header, Encapsulating security payloads, combining security associations, key management. Web Security: Secure socket layer and transport layer security, secure electronic transaction (SET). System Security: Intruders, Viruses and related threads, firewall design principals, trusted systems.

References:

1. William Stallings, "Cryptography and Network Security: Principals and Practice", Prentice Hall, New Jersy.

2. Johannes A. Buchmann, "Introduction to Cryptography", Springer-Verlag.

3. Bruce Schiener, "Applied Cryptography".

Advance Data base management system

BCS802	AdvanceDatabase management system	3L-0T-0P	CREDIT -3

Course outcome expected:

By the end of the course the students should be able to:

CO1: Exposure to fundamentals of DBMS and its importance.

CO2: Exposure for students to write complex queries including full outer joins, self-join, sub queries, and set theoretic queries, Cursor Management, Triggers, Transaction Processing & Locking using concept of Concurrency control.

CO3 Understand the importance of Functional Dependency and Functional Decomposition and apply normalization techniques.

CO4: Apply transaction management techniques to database.

CO5: Apply concurrency control methods on database.

Syllabus:

Unit I: Basics:

Formal review of relational database and FDs Implication, Closure, its correctness

Unit-II : Advanced SQL:

SQL for set theory queries, joins, Transactional Control(Commit, Save point) DCL Commands (Grant and Revoke) Types of locks on DB, Indexing, Views, Cursors, Triggers, Synonymes, Exceptions.

Unit-III : Functional Dependency and Decomposition:

Basics of Functional Dependency, Armstrong's Axioms for functional dependencies ,Redundant functional dependencies, Closures of a set of functional dependencies Type of FD, 1NF, 2NF,3NF and BCNF, Decomposition and synthesis approaches(Lossy Decomposition, Lossless join decomposition, Dependency-Preserving Decomposition)

Unit-IV : Transaction:

Introduction to transaction concepts, DB transactions, ACID properties, interleaved executions, schedules, serializability, Correctness of interleaved execution

Unit-V : Concurrency:

Concurrency, Methods for Concurrency, Comparison of CC methods, dynamic databases, Failure classification, recovery algorithm.

Text Books:

1. R. Ramakrishnan, J. Gehrke, Database Management Systems, McGraw Hill, 2004
2. A. Silberschatz, H. Korth, S. Sudarshan, Database system concepts, 5/e, McGraw Hill, 2008

Departmental Elective

DATA COMPRESSION

DECS 501	**Data Compression**	**3L-0T-0P**	**CREDIT -3**

Course outcome expected:

By end of this course the student should be able to

C01 Students will able to understand important of data compression

Co2 Student will be able to learn application different type of compression

CO3 Student is able to select methods and techniques appropriate for the task

CO4 Student is able to develop the methods and tools for the given task

CO5.student will learn different type of Distortion criteria

SYLLABUS

Unit - I: Compression Techniques: Loss less compression, Lossy Compression, Measures of performance, Modeling and coding, Mathematical Preliminaries for Lossless compression: A brief introduction to information theory, Models: Physical models, Probability models, Markov models, composite source model, Coding: uniquely decodable codes, Prefix codes

Unit – II: The Huffman coding algorithm: Minimum variance Huffman codes, Adaptive Huffman coding: Update procedure, Encoding procedure, Decoding procedure. Golomb codes, Rice codes, Tunstall codes, Applications of Hoffman coding: Loss less image compression, Text compression, Audio Compression.

Unit-III: Coding a sequence, Generating a binary code, Comparison of Binary and Huffman coding, Applications: Bi-level image compression-The JBIG standard, JBIG2, Image compression. Dictionary Techniques: Introduction, Static Dictionary: Diagram Coding, Adaptive Dictionary. The LZ77 Approach, The LZ78 Approach, Applications: File Compression-UNIX compress, Image Compression: The Graphics Interchange Format (GIF), Compression over Modems: V.42 bits, Predictive Coding: Prediction with Partial match (ppm): The basic algorithm, The ESCAPE SYMBOL, length of context, The Exclusion Principle, The Burrows-Wheeler Transform: Moveto-front coding, CALIC, JPEG-LS, Multi-resolution Approaches, Facsimile Encoding, Dynamic Markoy Compression

Unit – IV: Distortion criteria, Models, Scalar Ouantization: The Quantization problem, Uniform Quantizer, Adaptive Quantization, Non uniform Quantization.

Unit-V: Advantages of Vector Quantization over Scalar Quantization, The Linde-Buzo-Gray Algorithm, Tree structured Vector Quantizers. Structured VectorQuantizers.

REFERENCES:

1. Khalid Sayood, Introduction to Data Compression, Morgan Kaufmann Publishers
2. Elements of Data Compression,Drozdek, Cengage Learning
3. Introduction to Data Compression, Second Edition,KhalidSayood,The Morgan aufmannSeries
4. Data Compression: The Complete Reference 4th Edition byDavid Salomon, Springer
5. Text Compression1st Edition by Timothy C. Bell Prentice Hall

DATA COMPRESSION

DECS-551	**Data Compression Lab**	**L-T-2P**	**CREDIT -1**

Course outcome expected:

By end of this course the student should be able to

CO1. Students will able to understand important of data compression

CO2. Student will be able to develop a reasonably sophisticated data compression application

CO3 Student is able to select methods and techniques appropriate for the task

CO4. Student is able to develop the methods and tools for the given task

LIST OF EXPERIMENT

1. Compress a file (bitmap format) having some diagram in it.Transfer the file to another system & decompress to display the original file.
2. Compress an audio file.Transfer the file to another system & decompress to display the original file.
3. Compress a video file.Transfer the file to another system & decompress to display the original file.
4. Implement Huffman coding with minimum variance, optimal,non-binary, extended and adaptive.
5. Implement applications and limitation of Huffman codes(Run length encoding, Arithmetic coding, Predictive coding)
6. Implement Lossy compression techniques-JPEG.
7. Implement dictionary based compression- Lempel-Ziv-Welch, LZ77 and LZ-78
8. Implement Shannon Fano Algorithm

COMPUTER GRAPHICS

DECS-502	**Computer Graphics**	**3L-T-P**	**CREDIT -3**

Course outcome expected:

By end of this course the student should be able to

CO1:-To know the foundations of computer graphics.

CO2:-To comprehend the concept of geometric, mathematical and algorithmic concepts necessary for programming computer graphics

CO3:-To understand the comprehension of windows, clipping and view-ports object representation in relation to images displayed on screen.

CO4:- To apply the concept of 3D transformation for the creation of objects

CO5:-To understand the basics of curves and surfaces and to recognize the software utilized in constructing computer graphics applications

SYLLABUS

Unit – I Introduction and Line Generation: Types of computer graphics, Graphic Displays- Random scan displays, Raster scan displays, Frame buffer and video controller, Points and lines, Line drawing algorithms, Circle generating algorithms, Mid-point circle generating algorithm, and parallel version of these algorithms.

Unit – II Transformations: Basic transformation, Matrix representations and homogenous coordinates, Composite transformations, Reflections and shearing.

Unit –III Windowing and Clipping: Viewing pipeline, Viewing transformations, 2-D Clipping algorithms-Line clipping algorithms such as Cohen Sutherland line clipping algorithm, Liang Barsky algorithm, Line clipping against non-rectangular clip windows; Polygon clipping – Sutherland Hodgeman polygon clipping, Curve clipping, Text clipping.

Unit – IV Three Dimensional: 3-D geometric primitives, 3-D Object representation, 3-D Transformation, 3-D viewing, projections, 3-D Clipping.

Unit – V Curves and Surfaces:Quadric surfaces, Spheres, Ellipsoid, Blobby objects, introductory concepts of Spline, B-spline and Bezier curves and surfaces. Hidden Lines and Surfaces:Back Face Detection algorithm, Depth buffer method, A- buffer method, Scan line method, basic illumination models– Ambient light, diffuse reflection, specular reflection

References :

1. Donald Hearn and M Pauline Baker, “Computer Graphics C Version”, Pearson Education

2. Amrendra N Sinha and Arun D Udai,” Computer Graphics”, Tata MCGraw Hill.

3. Donald Hearn and M Pauline Baker, “Computer Graphics with OpenGL”, Pearson education

4. R.K. Maurya, “Computer Graphics ” Wiley Dreamtech Publication.

5. Rogers, " Procedural Elements of Computer Graphics", McGraw Hill

6. Mukherjee, Fundamentals of Computer graphics & Multimedia, PHI Learning Private Limited, Delhi India.

7.Foley, Vandam, Feiner, Hughes – "Computer Graphics principle", Pearson Education.

DECS 552	Computer Graphics lab	0L-0T-2P	CREDIT -1

Course outcome expected:

By end of this course the student should be able to

CO1. To implement the line and circle drawing algorithm

CO2. To implement the translation, rotation, scaling, reflection and sharing.

CO3. Execute scan line polygon filling

CO4 Implement basic transformations on objects

CO5 Implement clipping algorithm on lines

LIST OF EXPERIMENT

1. To implement DDA algorithms for line and circle.
2. To implement Bresenham's algorithms for line, circle and ellipse drawing
3. To implement Mid-Point Circle algorithm using C.
4. To implement Mid-Point Ellipse algorithm using C.
5. To perform 2D Transformations such as translation, rotation, scaling, reflection and sharing.
6. To implement Cohen–Sutherland 2D clipping and window–viewport mapping.
7. To implement Liang Barksy Line Clipping Algorithm.
8. To perform 3D Transformations such as translation, rotation and scaling.
9. To convert between color models.
10. To perform animation using any Animation software
11. To perform basic operations on image using any image editing software
12. To draw different shapes such as hut,face ,kite ,fish etc.

DATA MINING AND DATA WAREHOUS

DECS 503	**DATA MINING AND DATA WAREHOUSING**	**3L-T-P**	**CREDIT -3**

Course outcome expected:

By end of this course the student should be able to

CO1 Be familiar with mathematical foundations of data mining tools.

CO2 Understand and implement classical models and algorithms in data warehouses and data mining

CO3 Characterize the kinds of patterns that can be discovered by association rule mining, classification and clustering.

CO4 Master data mining techniques in various applications like social, scientific and environmental context.

CO5 Develop skill in selecting the appropriate data mining algorithm for solving practical problems.

SYLLABUS

UNIT – I Data Warehouse: Introduction to Data Ware House, Differences between operational database systems and data Ware House, Data Ware House characteristics, Data Ware House Architecture and its components, Extraction-Transformation-Loading, Logical (Mulit-Dimensional), Data Modeling, Schema Design, star and snow-Flake Schema, Fact Constellation, Fact Table, Fully Addictive, Semi-Addictive, Non-Addictive Measures; Fact-Less-Facts, Dimension Table characteristics; Fact-Less-Facts, Dimension Table characteristics; OLAP cube, OLAP Operations, OLAP Server Architecture-ROLAP, MOLAP and HOLAP.

UNIT – II Introduction to Data Mining: Introduction, What is Data Mining, Definition, KDD, Challenges, Data Mining Tasks, Data Preprocessing: Need for Preprocessing the Data, Data Cleaning, Data Integration and Transformation, Data Reduction, Discretization and Concept Hierarchy Generation.

UNIT – III Association Rules: Problem Definition, Frequent Item Set Generation, The APRIORI Principle, Support and Confidence Measures, Association Rule Generation, APRIORI Algorithm, The Partition Algorithms, FP-Growth Algorithms, Compact Representation of Frequent Item Set-Maximal Frequent Item Set, Closed Frequent Item Set.

UNIT –IV Classification: Problem definition, General Approaches to solving a classification problem, Evaluation of Classifiers, Classification techniques, Decision trees-Decision Tree Construction, Methods for expressing attribute test conditions, Measures for Selecting the Best split, Algorithm for Decision tree Induction, Naïve-Bayes Classifier, Bayesian Belief Networks; K-nearest neighbor classification-Algorithm and characteristics.

UNIT – V Clustering: Problem Definition, Clustering overview, Evaluation of clustering algorithms,Partitioning clustering K-Means Algorithm, K-Means Additional Issues, PAM Algorithm,Hierarchical Clustering-Algorithm- Agglomerative Methods and Divisive Methods, BasicAgglomerative Hierarchical Clustering Algorithm, Specific techniques, Key Issues inHierarchical Clustering, Strengths and weakness, Outlier Detection

TEXT BOOKS:

1) Data Mining-Concepts and Techniques- Jiawei Han, MichelineKamber, Morgan Kaufmann Publishers, Elsevier, 2 Edition, 2006.

2) Introduction to Data Mining, Pang-Ning Tan, Vipin Kumar, Michael Steinbanch, Pearson Education.

REFERENCES BOOKS:

1) Data Mining Techniques, Arun K Pujari, 3rd Edition, Universities Press.

2) Data Ware Housing Fundamentals, PualrajPonnaiah, Wiley Student Edition.

3) The Data Ware House Life Cycle Toolkit- Ralph Kimball, Wiley Student Edition.

4) Data Mining, VikaramPudi, P Radha Krishna, Oxford University.

DATA MINING AND DATA WAREHOUSING LAB

DECS 553	**DATA MINING AND DATA WAREHOUSING LAB**	**L-T-2P**	**CREDIT -1**

Course outcome expected:

By end of this course the student should be able to

CO1. To evaluate the different models of OLAP and data preprocessing.

CO2. To enlist various algorithms used in information analysis of Data Mining Techniques.

CO3 To demonstrate the knowledge retrieved through solving problems

LIST OF EXPERIMENT

1. List all the categorical (or nominal) attributes and the real-valued attributes separately.
2. .What attributes do you think might be crucial in making the credit assessment? Come up with some simple rules in plain English using your selected attributes.
3. .One type of model that you can create is a Decision Tree -train a Decision Tree using the complete dataset as the training data. Report the model obtained after training.
4. Suppose you use your above model trained on the complete dataset, and classify 16 credit good/bad for each of the examples in the dataset.
5. One approach for solving the problem encountered in the previous question is using 21 cross-validation? Describe what is cross -validation briefly. Train a Decision Tree again using cross -validation and report your results. Does your accuracy increase/decrease? Why?
6. Do you think it is a good idea to prefer simple decision trees instead of having long 34 complex decision trees? How does the complexity of a Decision Tree relate to the bias of the model?

DECS 601	Advance Computer architecture	3L-1T-P	CREDIT -4

Course outcome expected:

By end of this course the student should be able to

CO1 Understand the Concept of Parallel Processing and its applications

CO2 Implement the Hardware for Arithmetic Operations

CO3 Analyze the performance of different scalar Computers

CO4 Develop the Pipelining Concept for a given set of Instructions

CO5 Distinguish the performance of pipelining and non pipelining environment in a processor

SYLLABUS

UNIT 1 Pipeline and vector processing : Parallel Processing, Pipelining, Arithmetic Pipeline, Instruction Pipeline, RISC Pipeline, Vector Processing, Array Processors.

UNIT II Computer Arithmetic : Addition and Subtraction, Hardware Implementation, Multiplication Algorithms and Hardware Implementation, Division Algorithms and Hardware Implementation, Floating Point Arithmetic Operations.

UNIT III Parallel Computer Models : Evolution of Computer Architecture, System Attributes to Performance, Shared Memory Multiprocessors, Distributed Memory Multicomputers, Vector Super Computers, SIMD Super Computers.

UNIT IV Processors and Memory Hierarchy : Advanced Processor Technology: Design Space of Processors, Instruction-Set Architectures, CISC scalar Processors, RISC scalar Processors, Super Scalar and Vector Processors: Superscalar Processors.

UNIT V Pipelining and Superscalar Techniques : Linear Pipeline Processors: Asynchronous and Synchronous models, Clocking and Timing Control, Speedup, Efficiency and Throughput, Pipeline Schedule Optimization, Instruction Pipeline Design: Instruction Execution Phases, Mechanisms for Instruction Pipelining, Dynamic Instruction Scheduling, Branch Handling Techniques.

Text Books

1. Computer System Architecture, Morris M. Mano, 3rd edition, Pearson/Prentice Hall India.
2. Advanced Computer Architecture, Kai Hwang, McGraw-Hill, India.

References

1. Computer Organization and Achitecture, William Stallings ,8th edition,PHI
2. Computer Organization, Carl Hamachar, Vranesic,Zaky, 5th edition, McGraw Hill.

DECS 602	Mobile computing	3L-1T-P	CREDIT -4

Course outcome expected:

By end of this course the student should be able to

CO1: Understand and identify the GSM, CDMS and GPES for mobile computing

CO2: Understand the concept of wireless technology and WAP architecture .The ability to develop applications that are mobile-device specific and demonstrate current practice in mobile computing contexts.

CO3: To learn the concept of database management concept .Understanding of the characteristics and limitations of mobile hardware devices including their user-interface modalities

CO4: Analyze QOS over wire and wireless channels

CO5: Able to promote the awareness of the life-long learning, business ethics, professional ethics and current marketing scenarios.

SYLLABUS

Unit – I Introduction, issues in mobile computing, overview of wireless telephony: cellular concept, GSM: air-interface, channel structure, location management: HLR-VLR, hierarchical, handoffs, channel allocation in cellular systems, CDMA, GPRS.

Unit - II Wireless Networking, Wireless LAN Overview: MAC issues, IEEE 802.11, Blue Tooth, Wireless multiple access protocols, TCP over wireless, Wireless applications, data broadcasting, Mobile IP, WAP: Architecture, protocol stack, application environment, applications.

Unit – III Data management issues, data replication for mobile computers, adaptive clustering for mobile wireless networks, file system, disconnected operations.

Unit - IV Mobile Agents computing, security and fault tolerance, transaction processing in mobile computing environment.

Unit – V Ad Hoc networks, localization, MAC issues, Routing protocols, global state routing (GSR), Destination sequenced distance vector routing (DSDV), Dynamic source routing (DSR), Ad Hoc on demand distance vector routing (AODV), Temporary ordered routing algorithm (TORA), QoS in Ad Hoc Networks, applications.

References

1. J. Schiller, Mobile Communications, Addison Wesley.

2. A. Mehrotra , GSM System Engineering.

3. M. V. D. Heijden, M. Taylor, Understanding WAP, Artech House.

4. Charles Perkins, Mobile IP, Addison Wesley.

5. Charles Perkins, Ad hoc Networks, Addison Wesley.

PARALLEL AND DISTRIBUTED COMPUTING

DECS 603	**PARALLEL AND DISTRIBUTED COMPUTING**	**3L-1T-P**	**CREDIT -4**

Course outcome expected:

By end of this course the student should be able to

CO 1: Develop programs with distributed parallelism, parallel debugging included;

CO 2: Construct parallel algorithms, i.e. identify parallelism in a given algorithm and implement **it;**

CO 3: Analyse properties such as efficiency, speedup etc., of parallel algorithms;

CO 4: Analyse performance of parallel algorithms**.**

CO 5: Understand different parallel and distributed paradigms and algorithms

SYLLABUS

UNIT I Introduction: Scope , issues, applications and challenges of Parallel and Distributed Computing

Parallel Programming Platforms: Implicit Parallelism: Trends in Microprocessor Architectures, Dichotomy of Parallel Computing Platforms, Physical Organization, Communication Costs in Parallel Machines, Routing Mechanisms for Interconnection Networks, GPU, coprocessing. Principles of Parallel Algorithm Design: Decomposition Techniques,Characteristics of Tasks and Interactions,Mapping Techniques for Load Balancing.

UNIT II CUDA programming model: Overview of CUDA, Isolating data to be used by parallelized

code, API function to allocate memory on parallel computing device, to transfer data, Concepts of

Threads, Blocks, Grids, Developing a kernel function to be executed by individual threads, Execution of kernel function by parallel threads, transferring data back to host processor with API function.

UNIT III Analytical Modeling of Parallel Programs: Sources of Overhead in Parallel Programs,

Performance Metrics for Parallel Systems, The Effect of Granularity on Performance, Scalability of

Parallel Systems, Minimum Execution Time and Minimum Cost-Optimal Execution Time

UNIT IV Dense Matrix Algorithms: Matrix-Vector Multiplication, Matrix-Matrix Multiplication, Issues in Sorting on Parallel Computers, Bubble Sort and Variants, Quick Sort, Other Sorting Algorithms Graph Algorithms: Minimum Spanning Tree: Prim's Algorithm, Single-Source Shortest Paths: Dijkstra's Algorithm, All-Pairs Shortest Paths, Transitive Closure, Connected Components, Algorithms for Sparse Graph

UNIT V Search Algorithms for Discrete Optimization Problems: Sequential Search Algorithms,

Parallel Depth-First Search, Parallel Best-First Search, Speedup Anomalies in Parallel Search Algorithms

Text books:

1. A Grama, AGupra, G Karypis, V Kumar. Introduction to Parallel Computing (2nd ed.). Addison Wesley, 2003.

2. C Lin, L Snyder. Principles of Parallel Programming. USA: Addison-Wesley Publishing Company, 2008.

3. J Jeffers, J Reinders. Intel Xeon Phi Coprocessor High-Performance Programming. Morgan Kaufmann Publishing and Elsevier, 2013.

4. T Mattson, B Sanders, B Massingill. Patterns for Parallel Programming. Addison-Wesley Professional, 2004.

EMBEDDED SYSTEM

DE-CS701	**Department Elective III**	**3L-0T-0P**	**CREDIT -3**

COURSE OUTCOME EXPECTED

- **CO1:** Describe the differences between the general computing system and the embedded system, also recognize the classification of embedded systems..
- **CO2**: Become aware of the architecture of the ATOM processor and its programming aspects (assembly Level)
- **CO3:** Become aware of interrupts, hyper threading and software optimization.
- **CO4:** Design real time embedded systems using the concepts of RTOS.
- **CO5:** Analyze various examples of embedded systems based on ATOM processor.

SYLLABUS

UNIT 1 Introduction to Embedded Systems: Introduction to Embedded Systems – The build process for embedded systems- Structural units in Embedded processor , selection of processor & memory devices- DMA – Memory management methods- Timer and Counting devices, Watchdog Timer, Real Time Clock, In circuit emulator, Target Hardware Debugging.

UNIT 2-Embedded Networking: Embedded Networking: Introduction, I/O Device Ports & Buses– Serial Bus communication protocols – RS232 standard – RS422 – RS485 – CAN Bus -Serial Peripheral Interface (SPI) – Inter Integrated Circuits (I2C) –need for device drivers.

UNIT 3.Embedded Firmware Development Environment: Embedded Product Development Life Cycleobjectives, different phases of EDLC, Modelling of EDLC; issues in Hardware-software Co-design, Data Flow Graph, state machine model, Sequential Program Model, concurrent Model, object oriented Model.

UNIT 4.RTOS Based Embedded System Design: Introduction to basic concepts of RTOS- Task, process & threads, interrupt routines in RTOS, Multiprocessing and Multitasking, Preemptive and non preemptive scheduling, Task communication shared memory, message passing-, Inter process Communication – synchronization between processes-semaphores, Mailbox, pipes, priority inversion, priority inheritance, comparison of Real time Operating systems: Vx Works, чC/OS-II, RT Linux.

UNIT 5.Embedded System Application Development: Design issues and techniques Case Study of Washing Machine- Automotive Application- Smart card System Application.

Web Technology

OE-CS702	**Department Elective III**	**3L-0T-0P**	**CREDIT -3**

COURSE OUTCOME EXPECTED

CO1 : Students are able to develop a dynamic webpage by the use of java script and DHTML.

CO2 : Students will be able to write a well formed / valid XML document.

CO3 : Students will be able to connect a java program to a DBMS and perform insert, update and delete operations on DBMS table.

CO4 : Students will be able to write a server side java application called Servlet to catch form data sent from client, process it and store it on database.

CO5 : Students will be able to write a server side java application called JSP to catch form data sent from client and store it on database.

SYLLABUS

Unit I

Introduction :Introduction and Web Development Strategies, History of Web and Internet, Protocols governing Web, Writing Web Projects, Connecting to Internet, Introduction to Internet services and tools, Introduction to client-server computing. Core Java: Introduction, Operator, Data type, Variable, Arrays, Methods & Classes, Inheritance, Package and Interface, Exception Handling, Multithread programming, I/O, Java Applet, String handling, Event handling, Introduction to AWT, AWT controls, Layout managers.

Unit II

Web Page Designing:HTML: list, table, images, frames, forms, CSS, Document type definition, XML: DTD, XML schemes, Object Models, presenting and using XML, Using XML Processors: DOM and SAX, Dynamic HTML.

Unit III

Scripting: Java script: Introduction, documents, forms, statements, functions, objects; introduction to AJAX, VB Script, Introduction to Java Beans, Advantage, Properties, BDK, Introduction to EJB, Java Beans API.

Unit IV

Server Site Programming: Introduction to active server pages (ASP), Introduction to Java Server Page (JSP), JSP Application Design, JSP objects, Conditional Processing, Declaring variables and methods, Sharing data between JSP pages, Sharing Session and Application Data, Database Programming using JDBC, development of java beans in JSP, Introduction to Servelets, Lifecycle, JSDK, Servlet API, Servlet Packages, Introduction to COM/DCOM/CORBA.

Unit V.

PHP (Hypertext Preprocessor): Introduction, syntax, variables, strings, operators, if-else, loop, switch, array, function, form, mail, file upload, session, error, exception, filter, PHP-ODBC,

Text books:

1. Burdman, Jessica, "Collaborative Web Development" Addison Wesley
2. Xavier, C, " Web Technology and Design" , New Age International
3. Ivan Bayross," HTML, DHTML, Java Script, Perl & CGI", BPB Publication
4. Bhave, "Programming with Java", Pearson Education
5. Herbert Schieldt, "The Complete Reference:Java", TMH.
6. Ullman, "PHP for the Web: Visual QuickStart Guide", Pearson Education
7. Margaret Levine Young, "The Complete Reference Internet", TMH
8. Naughton, Schildt, "The Complete Reference JAVA2", TMH
9. Balagurusamy E, "Programming in JAVA", TMH

References:

1. Ramesh Bangia, "Internet and Web Design" , New Age International
2. Ivan Bayross," HTML, DHTML, Java Script, Perl & CGI", BPB Publication
3. Deitel, "Java for programmers", Pearson Education
4. Chris Bates, "Web Programing Building Internet Applications", 2nd Edition, WILEY, Dreamtech
5. Joel Sklar , "Principal of web Design" Vikash and Thomas Learning
6. Horstmann, "CoreJava", Addison Wesley

MOBILE APPLICATION DEVELOPMENT

DE-CS703	**Department Elective III**	**3L-0T-0P**	**CREDIT -3**

COURSE OUTCOME :

At the end of this course student will:

CO1: Apply essential Android Programming concepts.

CO2: Develop various Android applications related to layouts & rich uses interactive interfaces

CO3: Develop Android applications related to mobile related server-less database like SQLITE

SYLLABUS

UNIT I

INTRODUCTION: Introduction to mobile applications – Embedded systems - Market and business drivers for mobile applications – Publishing and delivery of mobile applications – Requirements gathering and validation for mobile applications

UNIT II

BASIC DESIGN: Introduction – Basics of embedded systems design – Embedded OS - Design constraints for mobile applications, both hardware and software related – Architecting mobile applications – User interfaces for mobile applications – touch events and gestures – Achieving quality constraints – performance, usability, security, availability and modifiability.

UNIT III

ADVANCED DESIGN: Designing applications with multimedia and web access capabilities – Integration with GPS and social media networking applications – Accessing applications hosted in a cloud computing environment – Design patterns for mobile applications.

UNIT IV

TECHNOLOGY I – ANDROID: Introduction – Establishing the development environment – Android architecture – Activities and views – Interacting with UI – Persisting data using SQLite – Packaging and deployment – Interaction with server side applications – Using Google Maps, GPS and Wifi – Integration with social media applications.

UNIT V

TECHNOLOGY II – iOS: Introduction to Objective C – iOS features – UI implementation – Touch frameworks – Data persistence using Core Data and SQLite – Location aware applications using Core Location and Map Kit – Integrating calendar and address book with social media application – Using Wifi - iPhone marketplace. Swift: Introduction to Swift, features of swift.

REFERENCES:

1. Charlie Collins, Michael Galpin and Matthias Kappler, “Android in Practice”, DreamTech, 2012
2. AnubhavPradhan , Anil V Despande Composing Mobile Apps,Learn ,explore,apply
3. James Dovey and Ash Furrow, “Beginning Objective C”, Apress, 2012
4. Jeff McWherter and Scott Gowell, "Professional Mobile Application Development", Wrox, 2012
5. David Mark, Jack Nutting, Jeff LaMarche and Frederic Olsson, “Beginning iOS
6 Development: Exploring the iOS SDK”, Apress, 2013.

Machine Learning

DE-CS801	**Department Elective IV**	**3L-1T-0P**	**CREDIT -4**

COURSE OUTCOME EXPECTED

By the end of the course the students should be able to:

CO1: Gain knowledge about basic concepts of Machine Learning

CO2: Identify machine learning techniques suitable for a given problem

CO3: Solve the problems using various machine learning techniques

CO4: Apply Dimensionality reduction techniques.

CO5: Design application using machine learning techniques

SYLLABUS

UNIT 1. INTRODUCTION – Well defined learning problems, Designing a Learning System, Issues in Machine Learning; THE CONCEPT LEARNING TASK - General-to-specific ordering of hypotheses, Find-S, List then eliminate algorithm, Candidate elimination algorithm, Inductive bias

UNIT 2.DECISION TREE LEARNING - Decision tree learning algorithm-Inductive bias- Issues in Decision tree learning; **ARTIFICIAL NEURAL NETWORKS –** Perceptrons, Gradient descent and the Delta rule, Adaline, Multilayer networks, Derivation of backpropagation rule Backpropagation AlgorithmConvergence, Generalization;

UNIT 3.Evaluating Hypotheses: Estimating Hypotheses Accuracy, Basics of sampling Theory, Comparing Learning Algorithms; **Bayesian Learning**: Bayes theorem, Concept learning, Bayes Optimal Classifier, Naïve Bayes classifier, Bayesian belief networks, EM algorithm;

UNIT 4.Computational Learning Theory: Sample Complexity for Finite Hypothesis spaces, Sample Complexity for Infinite Hypothesis spaces, The Mistake Bound Model of Learning; INSTANCE-BASED LEARNING – k-Nearest Neighbour Learning, Locally Weighted Regression, Radial basis function networks, Case-based learning

UNIT 5.Genetic Algorithms: an illustrative example, Hypothesis space search, Genetic Programming, Models of Evolution and Learning; Learning first order rules-sequential covering algorithmsGeneral to specific beam search-FOIL; REINFORCEMENT LEARNING - The Learning Task, Q Learning.

TEXT BOOK

1. Tom M. Mitchell, ―Machine Learning, McGraw-Hill Education (India) Private Limited, 2013.

2. Ethem Alpaydin, ―Introduction to Machine Learning (Adaptive Computation and Machine Learning), The MIT Press 2004.

3. Stephen Marsland, ―Machine Learning: An Algorithmic Perspective, CRC Press, 2009.

4. Bishop, C., Pattern Recognition and Machine Learning. Berlin: Springer-Verlag

DEEP LEARNING

DE-CS802	**Department Elective IV**	**3L-1T-0P**	**CREDIT -4**

Course outcome expected

By the end of the course the students should be able to:

CO1.To understand the theory behind deep learning methods such as Convolutional Neural Networks, Autoencoders and Boltzmann Machines,

CO2.To have a grasp of the open issues and trends in deep learning research,

CO3 To have a feeling of when to use or avoid deep learning methods.

SYLLABUS

UNIT 1 INTRODUCTION : Introduction to machine learning- Linear models (SVMs and Perceptrons, logistic regression)- Intro to Neural Nets: What a shallow network computes- Training a network: loss functions, back propagation and stochastic gradient descent- Neural networks as universal function approximates

UNIT 2 DEEP NETWORKS : History of Deep Learning- A Probabilistic Theory of Deep LearningBackpropagation and regularization, batch normalization- VC Dimension and Neural Nets-Deep Vs Shallow Networks-Convolutional Networks- Generative Adversarial Networks (GAN), Semisupervised Learning

UNIT 3 DIMENTIONALITY REDUCTION Linear (PCA, LDA) and manifolds, metric learning - Auto encoders and dimensionality reduction in networks - Introduction to Convnet - Architectures – AlexNet, VGG, Inception, ResNet - Training a Convnet: weights initialization, batch normalization, hyperparameter optimization

UNIT 4 OPTIMIZATION AND GENERALIZATION : Optimization in deep learning– Non-convex optimization for deep networks- Stochastic Optimization Generalization in neural networks- Spatial Transformer Networks- Recurrent networks, LSTM - Recurrent Neural Network Language Models- Word-Level RNNs & Deep Reinforcement Learning - Computational & Artificial Neuroscience

UNIT 5 CASE STUDY AND APPLICATIONS : Imagenet- Detection-Audio WaveNet-Natural Language Processing Word2Vec - Joint Detection-Bioinformatics- Face Recognition- Scene UnderstandingGathering Image Captions

TEXT BOOK

1. Cosma Rohilla Shalizi, Advanced Data Analysis from an Elementary Point of View, 2015.

2. Deng & Yu, Deep Learning: Methods and Applications, Now Publishers, 2013.

3. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press, 2016.

4. Michael Nielsen, Neural Networks and Deep Learning, Determination Press, 2015.

NATURAL LANGUAGE PROCESSING

DE-CS803	**Department Elective IV**	**3L-1T-0P**	**CREDIT -4**

COURSE OUTCOME EXPECTED

By the end of the course the students should be able to:

CO1: Summarize the concepts of automata and compiler

CO2: Learn the concepts of parsing and Normal forms of grammer .

CO3: Illustrate the concepts of semantic and pragmatic approach.

CO4: Learn the basic concepts of Speech processing

CO5: Analyse the concepts of pattern comparison technique and normalization .

SYLLABUS

Unit I

INTRODUCTION : Origins and challenges of NLP – Language Modeling: Grammar-based LM, Statistical LM – Regular Expressions, Finite-State Automata – English Morphology, Transducers for lexicon and rules, Tokenization, Detecting and Correcting Spelling Errors, Minimum Edit Distance WORD LEVEL ANALYSIS Unsmoothed N-grams, Evaluating N-grams, Smoothing, Interpolation and Backoff – Word Classes, Part-of-Speech Tagging, Rule-based, Stochastic and Transformation-based tagging, Issues in PoS tagging – Hidden Markov and Maximum Entropy models.

Unit II

SYNTACTIC ANALYSIS : Context-Free Grammars, Grammar rules for English, Treebanks, Normal Forms for grammar – Dependency Grammar – Syntactic Parsing, Ambiguity, Dynamic Programming parsing – Shallow parsing – Probabilistic CFG, Probabilistic CYK, Probabilistic Lexicalized CFGs – Feature structures, Unification of feature structures.

Unit III

SEMANTICS AND PRAGMATICS: Requirements for representation, First-Order Logic, Description Logics – Syntax-Driven Semantic analysis, Semantic attachments – Word Senses, Relations between Senses, Thematic Roles, selectional restrictions – Word Sense Disambiguation, WSD using Supervised, Dictionary & Thesaurus, Bootstrapping methods – Word Similarity using Thesaurus and Distributional methods.

Unit IV

BASIC CONCEPTS OF SPEECH PROCESSING: Speech Fundamentals: Articulatory Phonetics – Production And Classification Of Speech Sounds; Acoustic Phonetics – Acoustics Of Speech Production; Review Of Digital Signal Processing Concepts; Short-Time Fourier Transform, Filter-Bank And LPC Methods.

Unit V

SPEECH ANALYSIS: Features, Feature Extraction And Pattern Comparison Techniques: Speech Distortion Measures– Mathematical And Perceptual – Log–Spectral Distance, Cepstral Distances, Weighted Cepstral Distances And Filtering, Likelihood Distortions, Spectral Distortion Using A Warped Frequency Scale, LPC, PLP And MFCC Coefficients, Time Alignment And Normalization – Dynamic Time Warping, Multiple Time – Alignment Paths.

Text books:

1. Daniel Jurafsky, James H. Martin—Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech, Pearson Publication, 2014.
2. Steven Bird, Ewan Klein and Edward Loper, —Natural Language Processing with Python, First Edition, OReilly Media, 2009.
3. Lawrence RabinerAndBiing-Hwang Juang, "Fundamentals Of Speech Recognition", Pearson Education, 2003.
4. Daniel JurafskyAnd James H Martin, "Speech And Language Processing – An Introduction To Natural Language Processing, Computational Linguistics, And Speech Recognition", Pearson Education, 2002.
5. Frederick Jelinek, "Statistical Methods Of Speech Recognition", MIT Press, 1997.
6. 1. Breck Baldwin, —Language Processing with Java and LingPipe Cookbook, Atlantic Publisher, 2015. 7. Richard M Reese, —Natural Language Processing with Java, OReilly Media, 2015.
8. NitinIndurkhya and Fred J. Damerau, —Handbook of Natural Language Processing, Second Edition, Chapman and Hall/CRC Press, 2010.

OPEN ELECTIVES

OPERATION RESEARCH

OECS501	**OPERATION RESEARCH**	**3L-T-P**	**CREDIT-3**

Course outcome expected:

By end of this course the student should be able to

CO1 Express objective function and resource constraint in LP model in term of decision variable and parameters. CO**2.** Construct the initial transportation table for a trans-shipment problem and to solve a profit maximization transportation problem using suitable changes in the transportation algorithm.
CO3. Appreciate application of integer LP problem in several areas of managerial decision- making and to use linear programming approach to compute the value of the game when dominance rule do not apply.

CO4. Derive replacement policy for items whose running cost increases with time and to use various selective inventory control techniques to classify inventory items into broad categories.

CO5.Derive relationship among variety of performance measures using Probability Distributions and Dynamic Programming are used for Optimization.

SYLLABUS

UNIT-1 Introduction To Linear Programming : Definition and scope of operations research (OR), OR model, Problem Formulation and Application of LPP model, Graphical LPP solution, Simplex method, Big M-method, Two phase method, Special cases in Simplex method application, Duality in Linear Programming, Dual Simplex method, Sensitivity analysis, various industrial application of Linear Programming

UNIT-2 Linear Programming Extension -Transportation Models: Formulation and Optimal solution of Transportation problem, Method of finding Initial Solution – **NWCM,, LCM, VAM**, Close loop in Transportation Table and its properties, Variation in Transportation problem – Degeneracy and its resolution, Trans Shipment models, Assignment models - Hungarian method for solving Assignment Problem, Travelling Salesman problem.

UNIT-3 Integer Programming ,Game Theory ,Sequencing and Project Management:

Integer Programming -Formulation and solution of Integer linear programming problems, Enumeration and cutting plane solution concept, Branch and Bound algorithm. **Game Theory** : Introduction, Two person Zero Sum Game, Minimax and, Maximin Principles Rules of Dominance. **Sequencing problems**- Travelling Salesman problem, Machine-scheduling problem (Job shop). **Project Management-** Objectives of **CPM** and **PERT,** Characteristic of **CPM/PERT** projects**..**

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UNIT-4Replacement and Inventory models:

Replacement Problems- Optimal age of equipment replacement, Replacement of items that fail, Individual and group replacement policies.

Inventory models- Deterministic Inventory models, Classic **EOQ** model, **EOQ** with price breaks, single item Inventory control models without/with shortage, multi-item Inventory control models with constraints, single item Inventory control models with quantity discounts.

UNIT-5 Queuing Theory and Dynamic Programming:

Queuing Theory – Structure of a Queuing system,Probability Distribution in Queuing System, classification of Queuing models - Single server Queuing models/Multi server Queuing models.

Dynamic Programming- Dynamic Programming formulations, Bellman's principle of optimality, computation in Dynamic Programming, Forward and Backward recursions.

References:

1. Wayne L. Winston, "Operations Research" Thomson Learning,2003.
2. Hamdy H. Taha, "Operations Research-An Introduction" Pearson Education,2003.
3. R. Panneer Seevam, "Operations Research" PHI Learning, 2008.
4. V. K .Khanna, "Total Quality Management" New Age International, 2008.
5. Rao S.S. " Optimization Theory and Applications ", Willey Eastern Limited.
6. Taha H.A., " Operation Research-An Introduction ", Macmillan.
7. J .K. Sharma," Applied Operations Research", Trinity.

OECS 502	**GRAPH THEORY**	**3L-T-0P**	**CREDIT -3**

Course outcome expected:

By end of this course the student should be able to

After the course the student will have a strong background of the graph theory which has diverse applications in the area of computer science, biology, chemistry, physics & engineering.

SYLLABUS

UNIT 1.Graphs: Graphs, Sub graphs, some basic properties, various example of graphs & their sub graphs, walks, trails, path & circuits, connected graphs, disconnected graphs and its components, various operation on graphs, unicursal line, Euler graphs, Hamiltonian paths and circuits, Hamiltonian graph, traveling salesman problem, Chinese Postman problem. Fleury's algorithm for constructing an Euler line in a graph G, directed graphs, types of directed graphs, directed paths and connectedness, circuits in digraph, Hamiltonian and Euler digraphs.

UNIT 2.Trees: Trees and its characterization, distance, eccentricity and centre, diameters, radius of a tree and pendent vertices, rooted and binary trees, spanning trees, height of a binary tree, traversing binary tree, depth-first search and breath first search in a graph. Branches and chord, rank and nulity, on counting trees, trees with directed edges, fundamental circuits, finding all spanning trees of a graph and a weighted spanning tree, minimum weight spanning tree algorithm, , Prim's, Kruskal's and Dijkstra's algorithm.

UNIT 3. Cut sets & Network flow, Planar Graphs: Cuts sets and cut vertices, some properties, all cut sets in a graph, fundamental circuits and cut sets, connectivity in a graph and separable graph.

Transportation Networks: Networks flows, Max-flow-min cut theorem.
Planar Graphs: planar graphs, region and its degree, Euler's formula, Kuratowski's theorem and its application to planarity detection of graphs,dual graphs, combinational and geometrical dual, thickness and crossings.

UNIT 4.Matrix Representation and Colouring of Graphs: Incidence matrix of graph, sub matrices of A(G), circuit matrix, cut set matrix, fundamental circuit matrix and rank of matrix B, path matrix ,adjacency matrices, adjacency matrix of a digraph and their properties .**Colouring Of Graphs** : Colouring, , chromatic number, colour critical graph, chromatic partitioning, chromatic polynomials, matching, maximal matching, augmenting path, covering, minimal covering , Four colour problems, five colour theorem.

UNIT 5.Enumeration of graphs: Enumeration: types of enumeration, counting of labelled and unlabelled graphs and trees, cycle index of permutation group, Cayley's theorem, statement of Burnside's theorem, figure counting series and configuration series, Polya's Enumeration(or counting)theorem, Application of Polya's theorem in Graph Enumeration.

REFERENCE

1. Deo N., Graph Theory with Applications to Engineering and Computer Science, Prentice-Hall, Inc.
2. Bondy and Murthy: Graph theory and application. Addison Wesley.
3. John M. Aldous and Robin J. Wilson: Graphs and Applications-An Introductory Approach, Springer
4. Robin J, Wilson: Introduction to Graph Theory, Addison Wesley
5.Kalika Patraj: Graph theory, S.K. Kataria & Son's, N .Delhi.

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COMPUTER BASED NUMERICAL AND STATISTICAL TECHNIQUES

OECS 503	**COMPUTER BASED NUMERICAL AND STATISTICAL TECHNIQUES**	**3L-T-P**	**CREDIT -3**

Course outcome expected:

By end of this course the student should be able to

CO1. Analyse the asymptotic performance of algorithms.

CO2. Write rigorous correctness proofs for algorithms.

CO3. Demonstrate a familiarity with major algorithms and data structures.

CO4. Apply important algorithmic design paradigms and methods of analysis.

CO5. Synthesize efficient algorithms in common engineering design situations.

SYLLABUS

Unit 1: Introduction: Numbers and their accuracy,Mathematical preliminaries, Errors and their Computation, General error formula, Error in a series approximation.
Solution of Algebraic and Transcendental Equation: Bisection method, Iteration method, Aitken's Δ^2 method, method of False position, Newton-Raphson method, methods of finding complex roots, Rate of convergence of Iterative methods.

Unit-II: Interpolation: Finite Differences, Difference tables, Polynomial Interpolation**,** Newton's forward and backward formula Central Difference Formulae, Gauss forward and backward formula, Stirling's, Bessel's, Everett's formula. Interpolation with unequal intervals: Langrange's Interpolation, Newton Divided difference formula, Hermite's Interpolation.

Unit-III :Solution of Simultaneous Algebraic Equations: Gauss elimination method, Gauss Jordan method, Factorization method, Jacobi's method, Gauss-Seidal method.
Numerical Integration and Differentiation: Introduction, Numerical differentiation, Numerical Integration: Trapezoidal rule, Simpson's 1/3 and 3/8 rule, Boole's rule, Waddle's rule.

Unit-IVNumerical Solution of differential Equations: Introduction, Picard's method, Euler's method, Taylor's method, Runge-Kutta methods, Predictor Corrector methods (Milne's method & Adams-Bash-forth method).

Unit-VStatistical Computation: Moments, Central moments, Raw moments, Moments about the origin, Karl Pearson's $\beta and \gamma$ Coefficients, Moment generating function, Data fitting with Cubic splines, Correlation, Regression Analysis, Linear and Non linear Regression, Properties of Regression Coefficients.

References:

1. Rajaraman V, "Computer Oriented Numerical Methods", Pearson Education.

2. Gerald & Whealey, "Applied Numerical Analyses", AW.

3. Jain, Iyengar and Jain, "Numerical Methods for Scientific and Engineering Computations", New Age Int.

4. Grewal B S, "Numerical methods in Engineering and Science", Khanna Publishers, New Delhi.

5. T. Veerarajan, T. Ramachandran, “Theory and Problems in Numerical Methods,
TMH.

6. Pradip Niyogi, “Numerical Analysis and Algorithms”, TMH.

7. Francis Scheld, ” Numerical Analysis”, TMH.

8. Sastry S. S, “Introductory Methods of Numerical Analysis”, Pearson Education.

9. Gupta C.B., Vijay Gupta, “Introduction to Statistical Methods”, Vikas Publishing.

10. Goyal, M, “Computer Based Numerical and Statistical Techniques”, Firewall Media, New Delhi.

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Modeling and System simulation

OECS 601	**Modeling And System simulation**	**3L-0T-P**	**CREDIT -3**

Course outcome expected:

By end of this course the student should be able to

CO1: Understand the basics of simulation modeling and replicating the practical situations in organizations.

CO2: Realize Concepts in Discrete-Event Simulation and analyze and develop a number of simulation softwares.

CO3: understand and simulate various statistical and mathematical models

CO4: Generate random numbers and random variates using different techniques.

CO5: Analyze simulation data using input modelling as well as Understand Verification and Validation of simulation model.

SYLLABUS

Unit 1:Introduction- advantages and disadvantages of simulation, application areas in communication, computer and software design, systems and systems environment, components of a system, discrete and continuous systems, model of a system, types of models, discrete-event simulation, steps in a simulation study. Simulation Examples- Simulation of queueing systems, on-demand and inventory systems, simulation for reliability analysis etc.

Unit 2:General Principles: Concepts in Discrete-Event Simulation, List Processing: properties and operations, data structures and dynamic allocation, techniques.**Simulation Software:** Selection of Simulation Software, review of some existing softwares like: Arena, AutoMod, Extend, Flexsim, Micro Saint, ProModel, Quest, SIMUL8, WITNESS etc., Experimentation and Statistical-Analysis Tools.

Unit 3: Statistical Models in Simulation: Useful Statistical Models, Discrete Distribution s, Continuous Distributions, Poisson Process, Empirical Distributions.**Queuing Models:** Characteristics of Queuing systems, Queuing Notation, Long Run Measures of performance of Queuing Systems, Steady State Behavior of infinite Population Markovian Models, Steady State Behavior of finite Population Models, Networks of Queues.

Unit 4:Random Number Generation: Properties of Random Numbers, Generation of Pseudo-Random Numbers, Techniques for Generating Random Numbers, Tests for Random Numbers, Inverse transform Techniques, Convolution Methods, and Acceptance –Rejection Techniques.

Unit 5:Input Modeling: Data collection, Identifying the Distribution with Data: Histograms, Selection of the Appropriate Family of Distributions, Quantile-Quantile Plots. Parameter Estimation: Sample Mean and Sample Variance and various biased and unbiased Estimators. Goodness of Fit Tests, Multivariate and Time-Series Input Models .**Verification and Validation of Simulation Models:** Model Building, Verification & Validation, Verification of simulation Models, Calibration & Validation of Models.

Suggested Readings/ Books:

1. Jerry Banks, John S. Carson II, Barry L. Nelson and David M. Nicol, Discrete-Event System and Simulation, Prentice Hall of India, New Delhi, 2005.

2. Deo Narsingh, “System Simulation with Digital Computers”, PHI, New Delhi 1993.

3. Gordon G, “System Simulation”, PHI 2nd Edition 1998.

4. Gabriel A. Wainer, Discrete-event modeling and simulation: a practitioner's approach, CRC Press, 2009.

5. K S Trivedi, “Probability and Statistics with Reliability, Queuing and Computer Science Application”, PHI

6. Kleinrock, L.: Queuing Systems Vol.I, Vol.II, Wiley & Sons, London, 1975.

Internet Of Thing

OECS602	**Internet Of Thing**	**3L-0T-0P**	**CREDIT-3**

Course outcome expected:

By end of this course the student should be able to

CO1:-To understand the fundamental concepts of IoT and apply them.

CO2:-To know the different hardware's used to embed them with IoT for the development of embedded applications.

CO3:-To learn the networking and communication aspects in IoT and analysis of different protocol used in IoT.

CO4:-Design and develop an application of IOT using ardunio platform.

CO5:-To comprehend the challenges faced for the development of an IoT application.

SYLLABUS

Unit I . Internet of Things (IoT): Vision, Definition, Conceptual Framework, Architectural view, technology behind IoT, Sources of the IoT, M2M Communication, IoT Examples . Design Principles for Connected Devices: IoT/M2M systems layers and design standardization, communication technologies, data enrichment and consolidation, ease of designing and affordability.

Unit II Hardware for IoT: Sensors, Digital sensors, actuators, radio frequency identification (RFID) technology, wireless sensor networks, participatory sensing technology. Embedded Platforms for IoT: Embedded computing basics, Overview of IOT supported Hardware platforms such as Arduino, NetArduino, Raspberry pi, Beagle Bone, Intel Galileo boards and ARM cortex.

Unit III Network & Communication aspects in IoT: Wireless Medium access issues, MAC protocol survey, Survey routing protocols, Sensor deployment & Node discovery, Data aggregation & dissemination

Unit IV Programming the Ardunio: Ardunio Platform Boards Anatomy, Ardunio IDE, coding, using emulator, using libraries, additions in ardunio, programming the ardunio for IoT.

Unit V Challenges in IoT Design challenges: Development Challenges, Security Challenges, Other challenges IoT Applications : Smart Metering, E-health, City Automation, Automotive Applications, home automation, smart cards, Communicating data with H/W units, mobiles, tablets, Designing of smart street lights in smart city.

References:

1.Olivier Hersent,DavidBoswarthick, Omar Elloumi"The Internet of Things key applications and protocols", willey
2. Jeeva Jose, Internet of Things, Khanna Publishing House
3. Michael Miller "The Internet of Things" by Pearson
4. Raj Kamal "INTERNET OF THINGS", McGraw-Hill, 1ST Edition, 2016
5. ArshdeepBahga, Vijay Madisetti" Internet of Things(A hands on approach)" 1ST edition, VPI publications,2014
6. Adrian McEwen,HakinCassimally "Designing the Internet of Things" Wiley India

Data science

OE-CS 701	Data science	**3L-0T-0P**	**CREDIT -4**

Course outcomes Expected

By the end of the course the students should be able to:

CO1.Describe what Data Science is and the skill sets needed to be a data scientist. • Explain in basic terms what Statistical Inference means. Identify probability distributions commonly used as foundations for statistical modeling. Fit a model to data.

CO2. Use R to carry out basic statistical modeling and analysis.

CO3. Explain the significance of exploratory data analysis (EDA) in data science. Apply basic tools (plots, graphs, summary statistics) to carry out EDA.

CO4. Describe the Data Science Process and how its components interact

CO5 Use APIs and other tools to scrap the Web and collect data. And Apply EDA and the Data Science process in a case study.

SYLLABUS

Unit 1. Introduction: What is Data Science? - Big Data and Data Science hype – and getting past the hype - Why now? – Datafication - Current landscape of perspectives - Skill sets needed . Statistical Inference - Populations and samples - Statistical modeling, probability distributions, fitting a model - Intro to R

Unit 2. Exploratory Data Analysis and the Data Science Process - Basic tools (plots, graphs and summary statistics) of EDA - Philosophy of EDA - The Data Science Process - Case Study: RealDirect (online real estate firm) Three Basic Machine Learning Algorithms - Linear Regression - k-Nearest Neighbors (k-NN) - k-means

Unit 5. One More Machine Learning Algorithm and Usage in Applications - Motivating application: Filtering Spam - Why Linear Regression and k-NN are poor choices for Filtering Spam - Naive Bayes and why it works for Filtering Spam - Data Wrangling: APIs and other tools for scrapping the Web Feature Generation and Feature Selection (Extracting Meaning From Data) - Motivating application: user (customer) retention - Feature Generation (brainstorming, role of domain expertise, and place for imagination) - Feature Selection algorithms – Filters; Wrappers; Decision Trees; Random Forests

Unit 4 Recommendation Systems: Building a User-Facing Data Product - Algorithmic ingredients of a Recommendation Engine - Dimensionality Reduction - Singular Value Decomposition - Principal Component Analysis - Exercise: build your own recommendation system 8. Mining Social-Network Graphs - Social networks as graphs - Clustering of graphs - Direct discovery of communities in graphs - Partitioning of graphs - Neighborhood properties in graphs

Unit 5. Data Visualization - Basic principles, ideas and tools for data visualization 3 - Examples of inspiring (industry) projects - Exercise: create your own visualization of a complex dataset 10. Data Science and Ethical Issues - Discussions on privacy, security, ethics - A look back at Data Science - Next-generation data scientists

References

Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk From The Frontline. O'Reilly. 2014.

• Jure Leskovek, Anand Rajaraman and Jeffrey Ullman. Mining of Massive Datasets. v2.1, Cambridge University Press. 2014. (free online)

• Kevin P. Murphy. Machine Learning: A Probabilistic Perspective. ISBN 0262018020. 2013.

• Foster Provost and Tom Fawcett. Data Science for Business: What You Need to Know about Data Mining and Data-analytic Thinking. ISBN 1449361323. 2013.

• Trevor Hastie, Robert Tibshirani and Jerome Friedman. Elements of Statistical Learning, Second Edition. ISBN 0387952845. 2009. (free online)

• Avrim Blum, John Hopcroft and Ravindran Kannan. Foundations of Data Science

• Mohammed J. Zaki and Wagner Miera Jr. Data Mining and Analysis: Fundamental Concepts and Algorithms. Cambridge University Press. 2014.

• Jiawei Han, Micheline Kamber and Jian Pei. Data Mining: Concepts and Techniques, Third Edition. ISBN 0123814790. 2011.

BIG DATA ANALYTICS

OE-CS702	**Open Elective III**	**3L-0T-0P**	**CREDIT -4**

COURSE OUTCOME EXPECTED:

By the end of the course the students should be able to:

CO1:- To know the fundamental concepts of big data and analytics.

CO2:- To understand the different way to classify the given data using different techniques.

CO3:- To explore tools and practices for working with big data

CO4:- To learn about stream computing.

CO5:- To know about the research that requires the integration of large amounts of data.

SYLLABUS

UNIT I

INTRODUCTION TO BIG DATA

Evolution of Big data - Best Practices for Big data Analytics - Big data characteristics - Validating - The Promotion of the Value of Big Data - Big Data Use Cases- Characteristics of Big Data Applications - Perception and Quantification of Value -Understanding Big Data Storage - A General Overview of High-Performance Architecture - HDFS - MapReduce and YARN - Map Reduce Programming Model

UNIT II

CLUSTERING AND CLASSIFICATION

Advanced Analytical Theory and Methods: Overview of Clustering - K-means.Overview of the Method - Determining the Number of Clusters - Diagnostics - Reasons to Choose and Cautions .- Classification: Decision Trees - Overview of a Decision Tree - The General Algorithm - Decision Tree Algorithms - Evaluating a Decision Tree - Decision Trees in R - Naïve Bayes - Bayes‘ Theorem - Naïve Bayes Classifier.

UNIT III

ASSOCIATION AND RECOMMENDATION SYSTEM

Advanced Analytical Theory and Methods: Association Rules - Overview - Apriori Algorithm - Evaluation of Candidate Rules - Applications of Association Rules - Finding Association& finding similarity.

Recommendation System: Collaborative Recommendation- Content Based Recommendation - Knowledge Based Recommendation- Hybrid Recommendation Approaches.

UNIT IV

STREAM MEMORY

Introduction to Streams Concepts – Stream Data Model and Architecture - Stream Computing, Sampling Data in a Stream – Filtering Streams – Counting Distinct Elements in a Stream – Estimating moments – Counting oneness in a Window – Decaying Window – Real time Analytics Platform (RTAP) applications - Case Studies - Real Time Sentiment Analysis, Stock Market Predictions. Using Graph Analytics for Big Data: Graph Analytics

UNIT V

NOSQL DATA MANAGEMENT FOR BIG DATA AND VISUALIZATION

NoSQL Databases : Schema-less Models‖: Increasing Flexibility for Data Manipulation-Key Value Stores- Document Stores - Tabular Stores - Object Data Stores - Graph Databases Hive – Sharding Hbase – Analyzing big data with twitter - Big data for E-Commerce Big data for blogs - Review of Basic Data Analytic Methods using R.

TEXT BOOKS:

1. Anand Rajaraman and Jeffrey David Ullman, "Mining of Massive Datasets", Cambridge University Press, 2012.

2. David Loshin, "Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph", Morgan Kaufmann/El sevier Publishers, 2013.

BLOCKCHAIN

OE-CS801	**Open Elective IV**	**3L-0T-0P**	**CREDIT -4**

Course outcome expected:

By the end of the course the students should be able to:

CO1: To explore of blockchain and its architecture.

CO2: Understand the consensus, Consensus protocols for Permissioned Blockchains.

CO3: understand the Hyperledger Fabric and its implementation.

CO4: Applies blockchain concept in Financial Software and Systems, trade/supply chain (use cases).

CO5: Applies blockchain concept for Government(use case).

SYLLABUS

Unit-I Introduction :
Introduction to Blockchain: Digital Money to Distributed Ledgers , Design Primitives: Protocols, Security, Consensus, Permissions, Privacy. Blockchain Architecture and Design: Basic crypto primitives: Hash, Signature,) Hashchain to Blockchain, Basic consensus mechanisms

Unit-II : Consensus: Requirements for the consensus protocols, Proof of Work (PoW), Scalability aspects of Blockchain consensus protocols Permissioned Blockchains:Design goals, Consensus protocols for Permissioned Blockchains

Unit-III : Hyperledger Fabric (A): Decomposing the consensus process , Hyperledger fabric components, Chaincode Design and Implementation Hyperledger Fabric (B): Beyond Chaincode: fabric SDK and Front End (b) Hyperledger composer tool

Unit-IV: Use case 1 : Blockchain in Financial Software and Systems (FSS): (i) Settlements, (ii) KYC, (iii) Capital markets, (iv) Insurance Use case 2: Blockchain in trade/supply chain: (i) P Provenance of goods, visibility, trade/supply chain finance, invoice management discounting, etc

Unit-V Use case 3: Blockchain for Government: (i) Digital identity, land records and other kinds of record keeping between government entities, (ii) public distribution system social

Text Books:

3. Mstering Bitcoin: Unlocking Digital Cryptocurrencies, by Andreas Antonopoulos
4. Blockchain by Melanie Swa, O'Reilly
5. Hyperledger Fabric - https://www.hyperledger.org/projects/fabric
6. Zero to Blockchain - An IBM Redbooks course, by Bob Dill, David Smits - https://www.redbooks.ibm.com/Redbooks.nsf/RedbookAbstracts/crse0401.html

Computer Vision

OE-CS802	**Open Elective IV**	**3L-0T-0P**	**CREDIT -4**

Course outcome expected:

By the end of the course the students should be able to:

CO1: To explore fundamental image processing techniques required for computer vision
CO2: Understand Image formation process and Generate 3D model from images.

CO3: Perform feature extraction and motion estimation on the images.

CO4: To perform shape analysis and perform segmentation.

CO5: Perform Object Analysis and do processing.

SYLLABUS

Unit-I Introduction :

Image Processing, Computer Vision and Computer Graphics , What is Computer Vision - Low-level, Mid-level, High-level , Overview of Diverse Computer Vision Applications: Document Image Analysis, Biometrics, Object Recognition, Tracking, Medical Image Analysis, Content-Based Image Retrieval, Video Data Processing, Multimedia, Virtual Reality and Augmented Reality.

Unit-II : Image Formation Models : Monocular imaging system , Radiosity: The 'Physics' of Image Formation, Radiance, Irradiance, BRDF, color etc, Orthographic & Perspective Projection,• Camera model and Camera calibration, Binocular imaging systems, Multiple views geometry, Structure determination, shape from shading , Photometric Stereo, Depth from Defocus , Construction of 3D model from images.

Unit-III :

Image Processing , Feature Extraction and Motion Estimation : Image preprocessing, Image representations (continuous and discrete) , Edge detection, Regularization theory , Optical computation , Stereo Vision , Motion estimation , Structure from motion

Unit-IV :

Shape Representation and Segmentation : Contour based representation, Region based representation, Deformable curves and surfaces , Snakes and active contours, Level set representations , Fourier and wavelet descriptors , Medial representations , Multiresolution analysis.

Unit-V

Object recognition and Image understanding: Hough transforms and other simple object recognition methods, Shape correspondence and shape matching, Principal component analysis , Shape priors for recognition, Pattern recognition methods, HMM, GMM and EM.

Text Books:

7. Computer Vision - A modern approach, by D. Forsyth and J. Ponce, Prentice Hall Robot Vision, by B. K. P. Horn, McGraw-Hill
8. Introductory Techniques for 3D Computer Vision, by E. Trucco and A. Verri, Publisher: Prentice Hall.
9. R. C. Gonzalez, R. E. Woods. Digital Image Processing. Addison Wesley Longman, Inc., 1992
10. D. H. Ballard, C. M. Brown. Computer Vision. Prentice-Hall, Englewood Cliffs, 1982.

Vision of the Department:

To become a centre of excellence in the field of Electronics & Communication Engineering by providing quality education and research to produce human resource to cater the needs of Industry and Society.

Mission of the Department:

M1: To provide the state-of-the-art infrastructure and employ competent & committed human resource for carrying out teaching and research.

M2: Developing strong foundations in core areas of Electronics & Communication Engineering by subsuming theory with extensive practical training and exposure to industry.

M3: Developing skilled professionals for Industry and R&D organizations.

M4: Developing value based socially committed professionalism for the holistic development

Program Educational Objectives:

The broad objective of the program is to facilitate the development of competent and successful professionals in tune with modern day technological and societal requirements. The department of Electronics and Communication at IET Khandari, has developed and maintain a well-defined set of educational objectives. The objectives undergo continuous review and modification to assure the quality of our program and graduates. The most recent version of our educational objective list is given below.

PEO 1: Graduates will have curiosity, desire to experiment, innovation and nature to work in team.

PEO 2: Graduates will be able to strengthen the fundamentals of Mathematics and Science, promote proficiency in Electronics and Communication engineering, soft skills and readiness for Industry & competitive exams and will have entrepreneurial talent.

PEO 3: Graduate will reflect social responsibility and life-long learning by inculcating integrity, accountability, cultural and environmental sensitivity

Program Specific Outcomes

PSO1: The ability to apply concepts in Electronics and Communication Engineering to design and implement complex systems in the areas related to Analog and Digital, Communication, Signal Processing, Microwave, VLSI, Embedded Systems etc

PSO2: The ability to comprehend the technological advancements in the usage of modern design tools for a variety of applications.

PEO-PO MAPPING

POs PEOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
PEO 1	3	2	3	3	3	2	1	1	3	2	3	1
PEO 2	3	3	3	3	3	3	2	2	2	3	3	2
PEO 3	1	1	3	1	1	3	3	3	3	1	2	3

Undergraduate Degree Courses in Engineering & Technology

BACHELOR OF ENGINEERING (ELECTRONICS & COMMUNICATION ENGINEERING)

General, Course structure & Theme
&
Semester-wise credit distribution

A. Definition of Credit:

1 Hr. Lecture (L) per week	1 credit
1 Hr. Tutorial (T) per week	1 credit
1 Hr. Practical (P) per week 2 Hours Practical (Lab)/week	0.5 credits 1 credit

B. Structure of Undergraduate Engineering program:

S. No.	Category	Suggested Breakup of Credits (Total 160)
1.	Basic Science Courses (BSC)	20
2.	Engineering Science Courses (ESC)	30
3.	Humanities, Social Science and Management Courses (HSMC)	10
4.	Professional Core Courses (PCC)	60
5.	Professional Elective Courses (PEC)	18
6.	Open Elective Courses (OEC)	14
7.	Seminar	2
8.	Project	10
9.	Internships in industry	8
10.	Mandatory Courses (MC)	NC
	Total Credits	172

E. Course code and definition:

Course code	**Definitions**
BSC	Basic Science Courses
ESC	Engineering Science Courses
HSMC	Humanities and Social Sciences including Management courses
PCC	Professional core courses
PEC	Professional Elective courses
OEC	Open Elective courses
LC	Laboratory course
MC	Mandatory courses

**Minor variation is allowed as per need of the respective disciplines.*

Table: Structure of B.E. Program

S. No.	Courses		Credits							Actual Credits
		Total Credits	I&II	III	IV	V	VI	VII	VIII	
1.	Basic Science Courses (BSC)	20	17	4						21
2.	Engineering Science Courses (ESC)	30	19	8	4					31
3.	Humanities, Social Science and Management Courses (HSMC)	10	4		3	3				10
4.	Professional Core Courses (PCC)	60		9	14	11	15	8	7	64
5.	Professional Elective Courses (PEC)	18				3	4	3	4	14
6.	Open Elective Courses (OEC)	14				3	3	3	4	13
7.	Seminar	2						2		02
8.	Project	10						3	7	10
9.	Internships in industry	8		2		2		3		07
10	Mandatory Courses (MC)	NC		Y	Y		Y			
	Total Credits	**172**	**40**	**23**	**21**	**22**	**22**	**22**	**22**	**172**

Institute of Engineering & Technology
Dr. Bhimrao Ambedkar University
Khandari Campus, Agra

B.E I Year (Semester-I) CSE, ECE & EE (Group - A)
Course Structure & Evaluation Scheme

(Effective from academic year 2019-20)

S No.	Code	Subject	Periods			Sessional Marks			End Semester Marks			Credit
			L	T	P	CT	TA	Total	TE	PE	Total	
1	BSC - 103	Mathematics-I	3	1	0	30	10	40	60	-	100	4
2	BSC - 101	Physics	3	1	0	30	10	40	60	-	100	4
3	BCS - 101	Problem Solving and Computer Programming using "C"	3	1	0	30	10	40	60	-	100	4
4	BME - 101	Engineering Graphics and Design	2	0	0	30	10	40	60	-	100	2
5	BEE - 101	Basic Electronics Engineering	2	0	0	30	10	40	60	-	100	2
6	BSC - 151	Physics Lab	0	0	2	20	20	40	-	60	100	1
7	BCS - 151	Problem Solving and Computer Programming using "C" Lab	0	0	2	20	20	40	-	60	100	1
8	BME - 151	Engineering Graphics and Design Lab	0	0	2	20	20	40	-	60	100	1
9	BEE - 151	Basic Electronics Engineering Lab	0	0	2	20	20	40	-	60	100	1
		Total	13	3	8	230	130	360	300	240	900	20

Group A : CSE, ECE & EE.

Institute of Engineering & Technology

Dr. Bhimrao Ambedkar University

Khandari Campus, Agra

B.E I Year (Semester-II) CSE, ECE & EE (Group - A)

Course Structure & Evaluation Scheme

S No.	Code	Subject	Periods			Sessional Marks			End Semester Marks			Credit
			L	T	P	CT	TA	Total	TE	PE	Total	
1	BSC - 203	Mathematics-II	3	1	0	30	10	40	60	-	100	4
2	BSC - 202	Chemistry	3	1	0	30	10	40	60	-	100	4
3	BHSM - 201	Professional English	2	0	0	30	10	40	60	-	100	2
4	BME - 202	Workshop Concepts	2	0	0	30	10	40	60	-	100	2
5	BEE - 201	Fundamentals of Electrical Engineering	3	1	0	30	10	40	60	-	100	4
6	BSC - 252	Chemistry Lab	0	0	2	20	20	40	-	60	100	1
7	BHSM - 251	Professional English Lab	0	0	2	20	20	40	-	60	100	1
8	BME - 252	Workshop Concepts Lab	0	0	2	20	20	40	-	60	100	1
9	BEC - 251	Fundamentals of Electrical Engineering Lab	0	0	2	20	20	40	-	60	100	1
		Total	13	3	8	230	130	360	300	240	900	20

Group A : CSE, ECE & EE.

B.E II Year (Semester-III) Electronics & Communication Engineering
Course Structure & Evaluation Scheme

S No.	Course Category	Course Code	Course Title	Periods			Sessional Marks			End Semester Marks			Credit
				L	T	P	CT	TA	Total	TE	PE	Total	
1	BSC	BSC 301	Mathematics III	4	-	-	30	10	40	60	-	100	4
2	PCC	BEC 301	Digital Electronics	4	-	-	30	10	40	60	-	100	4
3	PCC	BEC 302	Electronic Devices & Circuits	3	-	-	30	10	40	60	-	100	3
4	ESC	BEE 301	Network Analysis & Synthesis	3	1	-	30	10	40	60	-	100	4
5	ESC	BCS 302	Data Structure	3	-	-	30	10	40	60	-	100	3
6	MC	MC 302	Human Values & Professional Ethics	2	-	-	30	10	40	60	-	100	-
7	ESC	BCS 352	Data Structure Lab	-	-	2	20	20	40	-	60	100	1
8	PCC	BEC 351	Digital Electronics lab	-	-	2	20	20	40	-	60	100	1
9	PCC	BEC 352	Electronic Devices & Circuits Lab	-	-	2	20	20	40	-	60	100	1
10		BEC 354	Mini Project or Internship Assessment	-	-	-	-	-	100	-	-	100	2
			Total	19	1	6	240	120	460	360	180	1000	23

*The Mini Project or internship (4 weeks) conducted during summer break after II semester and will be assessed during III semester.

B.E II Year (Semester-IV) Electronics & Communication Engineering
Course Structure & Evaluation Scheme

S No.	Course Category	Course Code	Course Title	Periods			Sessional Marks			End Semester Marks			Credit
				L	T	P	CT	TA	Total	TE	PE	Total	
1	HSMC	BHSM 401	Industrial Management	3	-	-	30	10	40	60	-	100	3
2	PCC	BEC 401	Electromagnetic Theory	3	1	-	30	10	40	60	-	100	4
3	PCC	BEC 402	Microprocessor and its Applications	3	1	-	30	10	40	60	-	100	4
4	PCC	BEC 403	Signals& Systems	3	1	-	30	10	40	60	-	100	4
5	ESC	BCS 404	JAVA	3	-	-	30	10	40	60	-	100	3
6	MC	MC 401	Environment and Ecology	2	-	-	30	10	40	60	-	100	-
7	PCC	BEC 451	PCB Design Lab	-	-	2	20	20	40	-	60	100	1
8	PCC	BEC 452	Microprocessor and its Applications Lab	-	-	2	20	20	40	-	60	100	1
9	ESC	BCS 454	JAVA Lab	-	-	2	20	20	40	-	60	100	1
			Total	17	3	6	240	120	360	360	180	900	21

B.E III Year (Semester-V) Electronics & Communication Engineering
Course Structure & Evaluation Scheme

S No.	Course Category	Course Code	Course Title	Periods			Sessional Marks			End Semester Marks			Credit
				L	T	P	CT	TA	Total	TE	PE	Total	
1	BHMC	BHSM 501	Economics for Industry	3			30	10	40	60	-	100	3
2	PCC	BEC 501	Antenna & Wave Propagation	3		-	30	10	40	60	-	100	3
3	PCC	BEC 502	Automatic Control Systems	3		-	30	10	40	60	-	100	3
4	PCC	BEC 503	Electronic Measurement & Instrumentation	3		-	30	10	40	60	-	100	3
5	PEC	DE-EC 501-505	Departmental Elective-1	3		-	30	10	40	60	-	100	3
6	OEC	OE-EC 501-514	Open Elective-1	3		-	30	10	40	60	-	100	3
7	PCC	BEC 552	Automatic Control Systems Lab	-	-	2	20	20	40	-	60	100	1
8	PCC	BEC 553	Electronic Measurement & Instrumentation Lab	-	-	2	20	20	40	-	60	100	1
9		BEC 555	Internship						100			100	2
			Total	18		4	220	100	420	360	120	900	22

*The internship (4 weeks) conducted during summer break after IV semester and will be assessed during V semester.

B.E III Year (Semester-VI) Electronics & Communication Engineering
Course Structure & Evaluation Scheme

S No.	Course Category	Course Code	Course Title	Periods			Sessional Marks			End Semester Marks			Credit
				L	T	P	CT	TA	Total	TE	PE	Total	
1	PCC	BEC 601	Analog Communications	3	1	-	30	10	40	60	-	100	4
2	PCC	BEC 602	Digital Signal Processing	3	1	-	30	10	40	60	-	100	4
3	PCC	BEC 603	Linear Integrated Circuits	3	1	-	30	10	40	60	-	100	4
4	PEC	DE-EC 601-605	Departmental Elective-2	4		-	30	10	40	60	-	100	4
5	OEC	OE-EC 601-614	Open Eletive-2	3		-	30	10	40	60	-	100	3
6	MC	OHS 601	Occupational Health & Safety	2		-	30	10	40	60	-	100	
7	PCC	BEC 651	Analog Communications Lab	-	-	2	20	20	40		60	100	1
8	PCC	BEC 652	Digital Signal Processing Lab	-	-	2	20	20	40	-	60	100	1
9	PCC	BEC 653	Linear Integrated Circuits Lab	-	-	2	20	20	40		60	100	1
			Total	17	4	6	240	120	360	360	180	900	22

B.E IV Year (Semester-VII) Electronics & Communication Engineering
Course Structure & Evaluation Scheme

S No.	Course Category	Course Code	Course Title	Periods			Sessional Marks			End Semester Marks			Credit
				L	T	P	CT	TA	Total	TE	PE	Total	
1	PCC	BEC701	Digital Communications	3		-	30	10	40	60	-	100	3
2	PCC	BEC702	Wireless & Mobile Communication	3		-	30	10	40	60	-	100	3
3	PEC	DE-EC 701-705	Departmental Elective-3	3		-	30	10	40	60	-	100	3
4	OEC	OE-EC 701-714	Open Elective-3	3	-	-	30	10	40	60	-	100	3
5	PCC	BEC751	Digital Communications Lab	-	-	2	20	20	40		60	100	1
6	PCC	BEC752	Wireless & Mobile Communication Lab	-	-	2	20	20	40		60	100	1
7		BEC 753	Seminar			4			100	-		100	2
8		BEC 754	Internship Assessment						100			100	3
9		BECP 755	Minor Project	-					40		60	100	3
			Total	12		8	160	80	480	240	180	900	22

*The internship (4 - 6 weeks) conducted during summer break after VI semester and will be assessed during VII semester.

B.E IV Year (Semester-VIII) Electronics & Communication Engineering
Course Structure & Evaluation Scheme

S No.	Course Category	Course Code	Course Title	Periods			Sessional Marks			End Semester Marks			Credit
				L	T	P	CT	TA	Total	TE	PE	Total	
1	PCC	BEC 801	Optical Communications	3	-	-	30	10	40	60	-	100	3
2	PCC	BEC 802	Satellite Communication	3	-	-	30	10	40	60	-	100	3
3	DEC	DE-EC 801-805	Departmental Elective-4	4	-	-	30	10	40	60	-	100	4
4	OEC	OE-EC 801-814	Open Elective-4	4	-	-	30	10	40	60	-	100	4
5	PCC	BEC 851	Optical Communications Lab	-	-	2	20	20	40		60	100	1
6		BECP 852	Major Project	-	-			200	200	-	200	400	7
7				14		2	140	260	400	240	260	900	22

Departmental Elective Courses		
DE-1	DE-EC 501 DE-EC 502 DE-EC 503 DE-EC 504 DE-EC 505 DE-EC 506	1. Electrical Engineering Materials 2. Electronics Circuit Switching 3. Process Control 4. Embedded Systems 5. Electronic Product design 6. MOOCs Course
DE-2	DE-EC 601 DE-EC 602 DE-EC 603 DE-EC 604 DE-EC 605 DE-EC 606	1. Power Electronics 2. High Speed Semiconductor devices 3. Optical Network 4. Consumer Electronics 5. Computer Networks 6. MOOCs Course
DE-3	DE-EC 701 DE-EC 702 DE-EC 703 DE-EC 704 DE-EC 705 DE-EC 706	1. VLSI 2. Nano-Electronics 3. Information Theory & Coding 4. Artificial Intelligence 5. Electromagnetic Interference 6. MOOCs Course
DE-4	DE-EC 801 DE-EC 802 DE-EC 803 DE-EC 804 DE-EC 805 DE-EC 806	1. Microwave and Radar Engineering 2. Digital Image Processing 3. Opto-Electronic Devices 4. IC Technology 5. Fuzzy Logic and Neural network 6. MOOCs Course

List of Open Electives		
Open Elective – I		
1.	OEC 501	Environmental Pollution and Management
2.	OEC 502	Urban and Town Planning
3.	OEC 503	**Laser System and its Application**
4.	OEC 504	**Bio- Medical Engineering**
5.	OEC 505	Industrial Engineering & Automation
6.	OEC 506	Total Quality Management
7.	OEC 507	Production Planning and Control
8.	OEC 508	Value Engineering
9.	OEC 509	Operation Research
10.	OEC 510	Graph Theory
11.	OEC 511	Computer Based Numerical and Statistical Techniques
12.	OEC 512	VLSI Circuits
Open Elective – II		
1.	OEC 601	Water Resources Conservation
2.	OEC 602	Environmental Management
3.	OEC 603	**Robotics**
4.	OEC 604	Mechatronics
5.	OEC 605	Composite Materials
6.	OEC 606	Entrepreneurship
7.	OEC 607	Mechanical System Design
8.	OEC 608	Product Development & Design
9.	OEC 609	Modeling And Simulation
10.	OEC 610	**Internet of Things**
11.	OEC 611	Electrical and Hybrid Vehicles
12.	OEC 612	**Nanoelectronics**

Open Elective – III		
1.	OEC 701	Finite Element Analysis
2.	OEC 702	Environment Impact Assessment
3.	OEC 703	**Digital System Design using VHDL**
4.	OEC 704	**Micro Electro Mechanical System**
5.	OEC 705	Non-Conventional Energy Resources
6.	OEC 706	**Nanotechnology**
7.	OEC 707	Non-Destructive Evaluation
8.	OEC 708	Introduction to Mechanical Micro Machining
9.	OEC 709	Data Science
10.	OEC 710	Big Data Analytics
11.	OEC 711	**Machine learning and Python Programming**
12.	OEC 712	**Embedded Systems**
Open Elective – IV		
1.	OEC 801	Remote Sensing And Geographic Information System
2.	OEC 802	Infrastructure Engineering
3.	OEC 803	Advance Sensors and Transducer
4.	OEC 804	**Multimedia Communication**
5.	OEC 805	Power Plant Engineering
6.	OEC 806	Optimization Methods in Engineering
7.	OEC 807	Fracture Mechanics
8.	OEC 808	Machine Tool Design
9.	OEC 809	Block chain
10.	OEC 810	Computer Vision
11.	OEC 811	Metro Systems and Engineering
12.	OEC 812	**Speech and Audio Processing**

BCS-301 Mathematics III

L-T-P-C
4-0-0-4

Course Outcomes: Upon successful completion of this course, students will be able to:

1. Solve the Fourier Transform of function.
2. Compute poles & zeros.
3. Evaluate the real & complex integrals with the help of Cauchy's Residue Theorem.
4. Utilize curve fitting techniques for data representations and computation in engineering analysis.
5. Use Binomial, Poisson & Normal Distribution to solve statistical problems.

Unit-1 (9 Hrs)

Fourier Transform: Fourier integral, conditions of convergence, Fourier sine and cosine integrals, complex form, applications, Inversion formula for Fourier transform, operational properties. Discrete and Fast Fourier transform. Applications of Fourier transform to solve boundary value problems.

Unit-2 (8 Hrs)

Functions of a Complex Variable and Conformal mapping: Limit, Continuity, Differentiability and Analyticity of functions of a complex variable, Cauchy-Riemann equations, Harmonic functions, Complex functions as mappings, Linear Transformation, Inverse transformation, Bilinear Transformations, Conformal Mapping & applications.

Unit-3 (9 Hrs)

Integration of Complex Functions: Contour integrals and evaluations, Cauchy's Theorem, Cauchy's Integral Formulae, Liouville's theorem, Convergence of power series, Taylor series, Laurent series, Zeros and Singularities of a complex function, Residues and Residue theorem, Evaluation of definite and improper integrals.

Unit-4 (7 Hrs)

Curve-fitting: method of least- squares, Normal equations, Normal equation in case of straight line, Fitting a straight line, Polynomial, non-linear and exponential curves, Change of origin.

Probability: Basics of probability, random variables, Expectation, Baye's theorem and probability distributions, Binomial, Poisson and Normal distributions.

Unit-5 (9 Hrs)

Statistical Methods: Sampling Theory, Parameters of Statistics, Tests of hypothesis and significance, z-test, t-test, $\chi 2$-test **,**Goodness of fit test**,** Time series analysis, Index numbers, Quality control chart and acceptance sampling, Introduction to design of experiments, Forecasting models.

Text & Reference Books:

1. R.K. Jain and S.R.K. Iyengar; Advanced Engineering Mathematics, Narosa Publishing House, 2002.
2. Erwin Kreyszig; Advanced Engineering Mathematics, John Wiley & Sons, 1962.
3. R.V. Churchill and J.L. Brown, Complex Variables and Applications, McGraw Hill, 1990.
4. B.S. Grewal, Higher Engineering Mathematics, Khanna Publisher, 2005.
5. J.H. Mathews and R.W. Howell, Complex analysis for Mathematics and Engineering, 3rd Ed. Narosa, 1998.

BEC 301 Digital Electronics

L-T-P-C
4-0-0-4

Course Outcomes: At the end of the course, students will demonstrate the ability to:

1. Understand binary codes, binary arithmetic, minimization techniques and their relevance to digital logic design.
2. Design & analyze modular combinational circuits with MUX/DEMUX, Decoder, Encoder and sequential logic circuits.
3. Understand finite state machines and develop a digital logic to find out sustainable solution of a real life problem.
4. Understand and implement various digital integrated circuits using different logic families and simple systems composed of PLDs.

Unit-1 (7 Hrs)

Digital Fundamentals: Number Systems – Decimal, Binary, Octal, Hexadecimal, 1's and 2's complements, Codes – Binary, BCD, Excess 3, Gray, Alphanumeric codes, Boolean theorems, Logic gates, Universal gates, Sum of products and product of sums, Minterms and Maxterms, Karnaugh map minimization and Quine-Mc Cluskey method of minimization.

Unit-2 (7 Hrs)

Combinational Logic Design: Design Examples: Arithmetic Circuits, BCD to 7 segment decoder, Code converters. Adders and their use as subtractor, look ahead carry, Digital Comparator, Parity generators, Multiplexers and their use in combinational logic designs, multiplexer, De-multiplexers and their use in combinational logic designs, Decoders, Demultiplexer.

Unit-3 (8 Hrs)

Sequential Logic Design: 1 Bit Memory Cell, Clocked SR, JK, MS J-K flip flop, D and T flip-flops. Use of preset and clear terminals, Excitation Table for flip flops. Conversion of flip flops. Application of flip flops: Registers, Shift registers, Counters, Sequence Generators, ripple counters, up/down counters, synchronous counters. Basic design steps-State diagram, State table, State reduction, State assignment, Mealy and Moore machines representation, Implementation, Finite state machine implementation.

Unit-4 (6 Hrs)

Digital Logic Families: Classification of logic families, Characteristics of digital ICs-Speed of operation, power dissipation, Figure of merit, Fan in, Fan out, Current and voltage parameters, Noise immunity, Operating temperatures and Power supply requirements, TTL logic. Operation of TTL NAND gate, Active pull up, Wired AND, Open collector output. Tri-State logic. CMOS logic –CMOS inverter, NAND, NOR gates, Wired logic, Open drain output. Interfacing CMOS and TTL. Comparison table of Characteristics of TTL, CMOS, ECL, RTL, I2L, DCTL.

Unit-5 (8 Hrs)

Programmable Logic Devices and Semiconductor Memories: Programmable logic devices: Detail architecture, Study of PROM, PAL, PLA, Designing combinational circuits using PLDs. General Architecture of FPGA and CPLD Semiconductor memories: memory organization and operation, expanding memory size, Classification and characteristics of memories, RAM, ROM, EPROM, EEPROM, NVRAM, SRAM, DRAM.

Text/ Reference Books:

1. R.P. Jain, Modern Digital Electronics, 3rd edition, 12th reprint, Tata McGraw Hill Publication, 2007.
2. M. Morris Mano, Digital Logic and Computer Design, 4th edition, Prentice Hall of India, 2013.
3. Anand Kumar, Fundamentals of digital circuits, 1st edition, Prentice Hall of India, 2001.
4. Tokheim, H. Roger L., Digital Electronics Principles & Application, 8th edition Tata McGraw-Hill, 2013.
5. NPTEL video lectures on Digital Circuits.

BEC 351 Digital Electronics Lab

L-T-P-C
0-0-2-1

Course Outcomes: At the end of the course, students will demonstrate the ability to:

1. Implement the basic digital theory concepts practically and will be able to verify various results derived in theory.
2. Design, analyze and troubleshoot broad range of combinational and sequential circuits for various practical problems using basic gates and flip flops I.C's.
3. Develop technical writing skills to communication effectively and present one's own work.
4. Acquire teamwork skills for finding sustainable solution of a complex problem and working effectively in groups.

List of experiments:

1. To study about logic gate and verify their Truth table.
2. To design and implement half adder and full adder.
3. To design and implement half subtractor and full subtractor
4. To design and implement 8:1 MUX.
5. To design and implement 1:8 DEMUX.
6. To design and implement Encoder.
7. To design and implement Decoder.
8. To design and implement R-S flip flop and J K flip flop
9. To design and implement D& T flip flop
10. To design and implement Master -Slave flip flop
11. To design and implement SISO AND SIPO.
12. To design and implement PISO and PIPO.
13. To design and implement DECADE counter

Text/Reference Books:

1. R.P. Jain, Modern digital Electronics, Tata McGraw Hill, 4th edition, 2009
2. A. Anand Kumar, Switching Theory & Logic Design, PHI.
3. W.H. Gothmann, Digital Electronics- An introduction to theory and practice, PHI, 2nd edition, 2006.

BEC 302 Electronic Devices & Circuits

L-T-P-C
3-0-0-3

Course Outcomes: At the end of the course, students will be able to:

1. Understand the working of switching devices and apply the same in designing complex circuits with fewer devices.
2. Design amplifier and other complex circuits with the help of special semiconductor devices which will further increase real time applications and reduce runaway situations.
3. Apply the mathematical modeling for the electronic devices and circuits in turn helps in improvement in design in terms of size, power requirement and ease of use.
4. Use variety of electronic devices for designing society friendly electronic gadgets used for security and other useful purposes.

Unit-1 (7 Hrs)

Semiconductor Physics- Mobility and conductivity, Charge densities in a semiconductor, Fermi Dirac distribution, Carrier concentrations and Fermi levels in semiconductor, Generation and recombination of charges, Diffusion and continuity equation, Mass action Law, Hall effect.

Unit-2 (8 Hrs)

Junction Diodes- Formation of homogenous and heterojunction diodes V-I characteristics, Small signal models of diode, Diode as a circuit element, Diode parameters and load line concept, Applications of diodes in rectifier, Clipping, Clamping circuits and voltage multipliers, Breakdown diodes, and Zener diode as voltage regulator

Special Semiconductor Devices: Optoelectronic Devices, Photoconductors, Photo Diode, Photo Transistor, Photo Voltaic Sensor, Photo Emission, Solar Cells, LED, LCD, Laser Diode, Schottky Diode

Unit-3(7 Hrs)

Small Signal Circuit: Two Port Network, Hybrid (H-Parameter)Model, Typical Values of H-Parameter Model, Conversion of CE, CB, CC Configuration to Equivalent Hybrid Model, CB Circuit Analysis, CE circuit with & without R_E analysis, CC circuit analysis, Analysis of CE, CB & CC Configuration with approximate Hybrid Model.

Unit-4 (8 Hrs)

FET: Introduction, The Junction FET, Basic Construction, Operation, P- Channel FET, N-Channel FET, High Frequency Model of FET, Low Frequency FET Amplifiers, Transfer Characteristics of FET, MOSFET, Enhancement Mode, Depletion Mode of FET, Circuit Symbol of MOSFET,V-MOSFET.

Unit-5 (9 Hrs)

Feedback Amplifiers and Oscillators: Principles of feedback in amplifiers advantages of negative feedback. Classification of feedback, voltage series, and voltage shunt, current series. Current – shunt effect of feedback on input and output impedance. Gain, stability, noise, distortion and band width Barkhausen criterion for sinusoidal oscillators. Phase shift oscillator. Wein-bridge oscillator, Hartley oscillator, Colpitts oscillator, crystal oscillator, frequency stability.

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Text/Reference Books:

1. Millman Halkias, Integrated Electronics, T.M.H
2. R.L. Boylestad, Louis Nashelsky, Electronic Devices & Circuits Theory, Pearson education

3. David Bell, Electronic Devices & Circuits, Oxford Publications
4. M. Rashid, Microelectronic Circuits : Analysis & Design, Cengage learning
5. Millman, Electronics Devices and Circuits, TMH
6. Electronic Devices,7edition, Floyd, Pearson 2008
7. A.S. Sedra and K.C. Smith, Microelectronic Circuits, Saunder's College Publishing
8. Shail Jain & D.R. Choudhary, Linear Integrated Circuit, PHI.

BEC 352 Electronic Devices & Circuits Lab

L-T-P-C
0-0-2-1

Course Outcomes: At the end of the course, students will be able to:

1. Understand the characteristics of diodes, transistors, JFETs..
2. Understand the operation and characteristics of different configurations of BJT.
3. Design complex electronic circuits with fewer devices.
4. Able to understand the concept and applications of feedback mechanism in electronic circuits.

List of experiments:

1. Study of Lab Equipments and Components: CRO, Multimeter, and Function Generator, Power supply- Active, Passive Components and Bread Board.
2. P-N Junction diode: Characteristics of PN Junction diode - Static and dynamic resistance measurement from graph.
3. Applications of PN Junction diode: Half & Full wave rectifier- Measurement of Vrms, Vdc, and ripple factor.
4. Characteristics of Zener diode: V-I characteristics of zener diode, Graphical measurement of forward and reverse resistance.
5. Application of Zener diode: Zener diode as voltage regulator. Measurement of percentage regulation by varying load resistor.
6. Characteristic of BJT: BJT in CE configuration- Graphical measurement of h-parameters from input and output characteristics. Measurement of Av, AI, Ro and Ri of CE amplifier with potential divider biasing.
7. Field Effect Transistors: Single stage Common source FET amplifier–plot of gain in dB Vs frequency, Measurement of, bandwidth, input impedance, maximum signal handling capacity (MSHC) of an amplifier.
8. Oscillators: Sinusoidal Oscillators a. Wein’s bridge oscillator b. phase shift oscillator.
9. Simulation of Amplifier circuits studied in the lab using any available simulation software.

Text/Reference Books:

1. Millman Halkias, Integrated Electronics, T.M.H
2. R.L. Boylestad, Louis Nashelsky, Electronic Devices & Crcuits Theory, Pearson education
3. David Bell, Electronic Devices & Circuits, Oxford Publications
4. M. Rashid, Microelectronic Circuits : Analysis & Design, Cengage learning
5. Millman, Electronics Devices and Circuits, TMH
6. Electronic Devices,7 edition, Floyd, Pearson 2008
7. A.S. Sedra and K.C. Smith, Microelectronic Circuits, Saunder's College Publishing
8. Shail Jain & D.R. Choudhary, Linear Integrated Circuit, PHI.

BEE 301 Network Analysis & Synthesis

L-T-P-C
3-1-0-4

Course Outcomes: At the end of this course students will demonstrate the ability to

1. Understand basics electrical circuits with nodal and mesh analysis.
2. Appreciate electrical network theorems.
3. Apply Laplace Transform for steady state and transient analysis.
4. Determine different network functions.

Unit-1 (9 Hrs)

Graph Theory- Graph of a network, Definitions, Tree, Co tree, Link, basic loop and basic cut set, Incidence matrix, Cut set matrix, Tie set matrix, Node and Mesh Analysis with dependent current and voltage sources. Mutual coupled circuits, Dot Convention in coupled circuits.

Unit-2 (7 Hrs)

Network Theorems (Applications to AC Networks)- Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem, Reciprocity theorem. Millman's theorem, Compensation theorem. Concept of duality and dual networks.

Unit-3 (9 Hrs)

Network Transient and steady state analysis-Solution of first and second order differential equations for Series and parallel R-L, R-C, R-L-C circuits, initial and final conditions in network elements, forced and free response, time constants, steady state and transient state response, Evaluation of time response both through classical and Laplace methods.

Unit -4 (10 Hrs)

Network Functions- Concept of complex frequency, Transform impedances network functions of one port and two port networks, Concept of poles and zeros, Properties of driving point and transfer functions.

Two Port Networks- Characterization of LTI two port networks; Z, Y, ABCD, A'B'C'D', g and h parameters, Reciprocity and symmetry, Inter-relationships between the parameters, Interconnections of two port networks, Ladder and Lattice networks: T & Π representation.

Unit-5(8 Hrs)

Network Synthesis- Positive real function; definition and properties, Properties of LC, RC and RL driving point functions, Synthesis of LC, RC and RL driving point immitance functions using Foster and Cauer first and second forms.

Text/Reference Books:

1. M. E. Van Valkenburg, Network Analysis, Prentice Hall of India
2. Alexander, Sadiku, Fundamentals of Electric Circuits, McGraw Hill
3. D. Roy Choudhary, Networks and Systems, Wiley Eastern Ltd.
4. C. L. Wadhwa, Network Analysis and Synthesis, New Age International Publishers
5. A. Chakrabarti, Circuit Theory, Dhanpat Rai & Co.
6. Hayt, Kimmerly, Durbin, Engineering Circuit Analysis, McGraw Hill
7. Donald E. Scott, An Introduction to Circuit analysis: A System Approach, McGraw Hill
8. M. E. Van Valkenburg, An Introduction to Modern Network Synthesis, Wiley Eastern Ltd.
9. T. S. K. V. Iyer, Circuit Theory, Tata McGraw Hill.
10. Joseph A. Edminister, Theory& Problems of Electric Circuits, McGraw Hill.

11. U.A Bakshi, V.A Bakshi, Network Theory , Technical Publications
12. C.K Alexander and Sadiku, Fundamentals of Electric Circuit, Indian Edition.
13. A.V. Oppenheim, A.S. Willsky, with S. Nawaab, Signals & Systems, Prentice Hall India

BCS 301 Data structure

L-T-P-C
3-0-0-3

Course Outcomes: At the end of this course students will demonstrate the ability to

1. To review the concepts of fundamental data structures to be used in programming. To understand various searching algorithms.
2. To understand the various operations on different types of data structures such as stacks, queues and linked lists. To apply and analyze various data structures on different applications.
3. To understand, analyze and compare various sorting algorithms. To understand the concept of hashing and its techniques.
4. To understand the various types of tree structures and their implementation. To evaluate various tree structures. To be able to apply tree structures on various problems.
5. To understand and implement various types of graphs**.** To study and implement various shortest path algorithms on graphs.

Unit-1 (8 Hrs)
Introduction: Basic concepts and notations, Mathematical background, Revision of arrays and pointers, Recursion and implementation of Recursion, Time and Space Complexity, Asymptotic notations: Big Oh, Big Theta and Big Omega, Time-Space trade-off.
Searching: linear search and binary search techniques.

Unit 2 (7 Hrs)
Stacks and Queues: Sequential representation of stacks and queues, Primitive Stack operations: Push & Pop, Application of stack: Prefix and Postfix Expressions, Evaluation of postfix expression, conversion of infix to postfix.
Lists: List representation techniques, Dynamics Storage allocation, Representation of stacks and queues using linked list, Operations on a Linked List: Insertion, Deletion, Traversal, Introduction to Doubly linked list, introduction to circularly linked list.

Unit 3 (8 Hrs)
Sorting Algorithms and hashing: Insertion sort, Bubble sort, Quick sort, Merge sort, Heap sort, Shell sort, Time and Space complexity of sorting algorithms, hashing.

Unit 4 (7 Hrs)
Trees: Definition and basic concepts, Linked tree **r**epresentations, Binary tree traversal algorithms,(Preorder, Inorder, Postorder), Binary search tree, Insertion and Deletion in Binary search tree, Multiway search trees, B trees, B+ tree and their applications.

Unit 5(6 Hrs)
Graphs: Introduction to Graphs, Data Structure for Graph Representations: Adjacency Matrices, Adjacency List, Graph Traversal: Depth First Search and Breadth First Search, Shortest Path algorithm: Warshal Algorithm and Dijikstra Algorithm.

Text Books and References:

1. Y. Langsam, M.J. Augenstein and A.M. Tenenbaum, Data Structure Using C and C++. Second Edition, Prentice Hall of India, 1997.
2. Seymour Lipschutz, Data Structures, Schaum's Outlines, Tata McGraw Hill , New Delhi, 2006
3. Lafore – Data structure & Algorithms in java, BPB Publication.
4. Sartaj Sahni – Data structure, Algorithms & application in C++ , McGraw Hill.

BCS 352 Data Structures Lab

L-T-P-C
0-0-2-1

Course Outcomes: At the end of the course, students will be able to:

1. Analyze the algorithms to determine the time and computation complexity and justify the correctness.
2. Implement search problem (Linear Search and Binary Search) .
3. For a given problem of Stacks, Queues and linked list student will able to implement it and analyze the same to determine the time and computation complexity.
4. Student will able to write an algorithm Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort and compare their performance in term of Space and Time complexity and will able to implement Graph search and traversal algorithms and determine the time and computation complexity.

Course Detail: Write Program in C / C++ for following:

List of experiments:

1. To implement stack using array.
2. To implement queue using array.
3. To implement circular queue using array.
4. To implement various operations on linked list:(a)insert (b)delete (c) display
5. To implement stack using linked list.
6. To implement queue using linked list.
7. To implement linear search.
8. To implement binary search.
9. To implement bubble sort.
10. To implement insertion sort.
11. To implement merge sort.
12. To implement quick sort.
13. Program to find the factorial of a number using recursion.
14. To implement Heap sort.
15. Implementation of graph menu driven program.

MC 302/MC 402 Human Values & Professional Ethics

L-T-P-C
2-0-0-0

Course Outcome: On completion of this course, the students will be able to:

1. Understand the significance of value inputs in a classroom, distinguish between values and skills, understand the need, basic guidelines, content and process of value education, explore the meaning of happiness and prosperity and do a correct appraisal of the current scenario in the society
2. Distinguish between the Self and the Body, understand the meaning of Harmony in the Self the Co-existence of Self and Body.
3. Understand the value of harmonious relationship based on trust, respect and other naturally acceptable feelings in human-human relationships and explore their role in ensuring a harmonious society.
4. Distinguish between ethical and unethical practices, and start working over the strategy to actualize a harmonious environment wherever they work.

Unit-1 (7 Hrs)

Course Introduction: Need, Basic Guidelines, Content and Process for Value Education Understanding the need, basic guidelines, content and process for Value Education, Self-Exploration–what is it? - its content and process; 'Natural Acceptance' and Experiential Validation- as the mechanism for self-exploration, Continuous Happiness and Prosperity- A look at basic Human Aspirations, Right understanding, Relationship and Physical Facilities- the basic requirements for fulfilment of aspirations of every human being with their correct priority, Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario, Method to fulfill the above human aspirations.

Unit-2 (7 Hrs)

Understanding Harmony in the Human Being: Harmony in Myself Understanding human being as a co-existence of the sentient 'I' and the material 'Body', Understanding the needs of Self ('I') and 'Body' - Sukh and Suvidha, Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer), Understanding the characteristics and activities of 'I' and harmony in 'I', Understanding the harmony of I with the Body: Sanyam and Swasthya; correct appraisal of Physical needs, meaning of Prosperity in detail, Programs to ensure Sanyam and Swasthya.

Unit-3 (7 Hrs)

Understanding Harmony in the Family and Society: Harmony in Human-Human Relationship Understanding harmony in the Family- the basic unit of human interaction, Understanding values in human-human relationship; meaning of Nyaya and program for its fulfillment to ensure Ubhay-tripti (Mutual Happiness); Trust (Vishwas) and Respect (Samman) as the foundational values of relationship, Understanding the meaning of Vishwas; Difference between intention and competence, Understanding the meaning of Samman, Difference between respect and disrespect; the other salient values in relationship, Understanding the harmony in the society (society being an extension of family): Samadhan, Samridhi, Abhay, Sah-astitva as comprehensive Human Goals, Visualizing a universal harmonious order in society.

Unit-4 (7 Hrs)

Understanding Harmony in the Nature and Existence: Whole existence as Co-existence Understanding the harmony in the Nature, Interconnectivity and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature, Understanding Existence as Co-existence (Sah-astitva) of mutually interacting units in all-pervasive space, Holistic perception of harmony at all levels of existence.

Unit-5 (7 Hrs)

Implications of the Holistic Understanding of Harmony on Professional Ethics Natural acceptance of human values, Definitiveness of Ethical Human Conduct, Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order, Competence in Professional Ethics: a) Ability to utilize the professional competence for augmenting universal human order, b) Ability to identify the scope and characteristics of people-friendly and eco friendly production systems, technologies and management models. Improving quality of work life at work place.

Text/References Books:

1. R R Gaur, R Sangal, G P Bagaria, A Foundation Course in Human Values and Professional Ethics, 2009.
2. A Nagraj, Jeevan Vidya EkParichay, Divya Path Sansthan, Amarkantak,1998.
3. R. Subramanian, Professional Ethics, 2017.
4. P L Dhar, RR Gaur, Science and Humanism, Commonwealth Publishers, 1990.
5. A N Tripathy, Human Values, New Age International Publishers, 2003..
6. Subhas Palekar, How to practice Natural Farming, Pracheen (Vaidik) KrishiTantraShodh, Amravati, 2000.
7. E G Seebauer & Robert L. Berry, Fundamentals of Ethics for Scientists &Engineers , Oxford University Press, 2000.
8. M Govindrajran, S Natrajan & V.S. Senthil Kumar, Engineering Ethics (including Human Values), Eastern Economy Edition, Prentice Hall of India Ltd.
9. B P Banerjee, Foundations of Ethics and Management, Excel Books, 2005.
10. B L Bajpai, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008.

BHSM 401 Industrial Management

L-T-P-C
3-0-0-3

Unit-1 (8 Hrs)
Introduction: Concept and scope of Industrial Management. Productivity: Definition, measurement, productivity index, types of production system, Industrial Ownership.

Unit-2 (7 Hrs)
Functions of Management, Taylor's Scientific Management Theory, Fayol's Principles of Management, Social responsibilities of Management, Introduction to Human resources management: Nature of HRM, functions and importance of HRM.

Unit-3 (7 Hrs)
Work Study: Introduction, definition, objectives, steps in work study, Method study: definition, objectives, steps of method study, Work Measurement: purpose, types of study — stop watch methods — steps — allowances — standard time calculations — work sampling, Production Planning and Control Inventory Control: Inventory, Cost, Models of inventory control: EOQ, ABC, VED

Unit-4 (7 Hrs)
Quality Control: statistical quality control, Control charts for variables and attributes, Acceptance Sampling-Single sampling- Double sampling plans, Introduction to TQM.

Unit-5 (5 Hrs)
Project Management: Project network analysis, CPM, PERT and Project crashing and resource leveling.

Text/Reference Books:

1. Engineering Management (Industrial Engineering & Management)/ S.C. Sharma & T.RBanga, Khanna Book Publishing Co. (P) Ltd., Delhi (ISBN: 978-93-86173-072)
2. Industrial Engineering and Management/ P. Khanna, Dhanpatrai publications Ltd.
3. Production & Operation Management /PaneerSelvam /PHI.
4. Industrial Engineering Management/NVS Raju/Cengage Learning.
5. Industrial Engineering Management I RaviShankar/ Galgotia.

BEC-401 Electromagnetic Theory

L-T-P-C
3-1-0-4

Course Outcomes: At the end of this course, student will have the ability to:

1. Understand the concepts of electromagnetic and magneto-statics
2. Understand and apply the time varying fields and Maxwell's equation to enhance various devices performance, hence upgrading its impact on society,
3. Analyse Uniform plane wave, Poynting vector and Flow of power to deign more efficient devices for improving communication capabilities in turn reduce impact of radiations.
4. Understand the basic concepts of transmission line and guided waves and apply them in designing better transmission line in terms of low power losses.

Unit-1 (10 Hrs)

Electrostatics and Magnetostatics: Review of vector calculus, Coulomb's law, Electric displacement and Displacement density, Lines of Force and Lines of Flux. Gauss's law, The potential function, Field of infinitesimal electric dipole, Field due to continuous distribution of charges, equipotential surfaces, Divergence Theorem, Poisson's Equation and Laplace's equation, Solution by means of Electrical images, Capacitance, Capacitance of parallel plate and coaxial cables, Energy in Electrostatic fields, Boundary conditions.

Unit-2 (8 Hrs)

Steady Magnetic Field: Magnetic field strength H, Magnetic flux density B, MMF, Ampere's circuital law, Ampere's law in differential vector form, Permeability, Energy stored in a Magnetic field, Ampere's law for a current element (Biot-Savart Law), Magnetic vector potential, Boundary conditions, Analogies between Electric and Magnetic fields.

Unit-3 (8 Hrs)

Time varying fields and Maxwell's equation: The Equation of continuity for Time-Varying Fields, Maxwell's Equations, Representation in Differential form, Integral form, Boundary conditions, Faraday's law of electromagnetic induction, Transformer and motional emf, Time harmonic field, Electromagnetic potential, Relation between circuit theory and field theory.

Unit-4 (8 Hrs)

Uniform plane wave: Wave equation: solution for Dielectric and Conducting media, free space propagation, Surface impedance, Depth of penetration (skin depth), phase velocity, and group Velocity, Polarization of uniform plane waves, Reflection by a Perfect conductor and perfect dielectric (normal and oblique incidence), Brewster Angle.

Poynting Vector and Flow of Power: Poynting theorem, Instantaneous average and Complex Poynting Vector.

Unit-5 (8 Hrs)

Transmission line and guided waves: Distributed parameters Model of Transmission Line, open wire and coaxial cable, Transmission line theory: line equation, lossless line, Voltage standing wave ratio (VSWR), Transmission line as circuit element, Quarter wave transformer, Impedance matching, single stub, Wave between parallel planes, TE waves, TM waves, characteristics of TE and TM waves, TEM waves and its properties.

Text/Reference Books:

1. Sadiku , Matthew N.O., Elements of Electromagnetics, Oxford University Press, 3rd Ed.
2. K. D. Prasad, Electromagnetic, Antenna, and wave Propagation,
3. Jorden &Balmein, Electromagnetic- Wave and radiating system, Tata McGraw-Hill.
4. Harington, R. F., Time Harmonic EM Fields, Tata McGraw Hill.
5. Collin, R. E, Antennas and Radio Wave Propagation, Tata McGraw Hill.
6. Pramanik, Ashutosh, Electromagnetism, Theory & Applications, Prentice Hall (India)
7. Schaum's Outlines, Electromagnetics, Tata McGraw Hill.
8. Kraus, Fleisch, Electromagnetics with Applications, 5^{th} Ed., Tata McGraw-Hill,
9. Hayt, Engineering Electromagnetic, (sixth edition)
10. J.F.D. Kraus, Electromagnetic-Antenna

BEC 402 Microprocessors and its Applications

L-T-P-C
3-1-0-4

Course Outcomes: At the end of this course, the students will:

1. (i) Recall and apply a basic concept of digital fundamentals to microprocessor based personal computer system and Recall the memory types and understand the interfacing of memory with microprocessor. (ii) Understand the internal architecture and organization of 8085 & 8086.
2. (i) Apply knowledge and demonstrate programming proficiency using the various addressing modes and data transfer instructions of the target microprocessor and microcontroller. (ii) Analyze assembly language programs; select appropriate assemble into machine a cross assembler utility of a microprocessor and microcontroller.
3. Discuss how the different peripherals are interfaced with microprocessor like 8255, 8253/54,8237,8279,etc.
4. (i)To analyze the concepts of memory interfacing for faster execution of instructions and improves the speed of operations & hence performance of microprocessors. (ii) To understand the basic knowledge of advanced processor and Analyze the internal architecture of 80286, 80486 and Pentium processor.
5. (i) Analyze the internal architecture and real time control of 8051. (ii) Analyze the internal architecture of ARM Processors.

Unit-1 (8 Hrs)
Introduction to Microprocessor: Evolution of Microprocessors, Register structure, ALU, Bus Organization, Timing and Control.
8-bit microprocessor: 8085 Microprocessor and its Architecture, Addressing Modes, The 8085 Programming Model, Instruction Classification, Instruction Format, Overview of Instruction set- Data Transfer Operation, Arithmetic Operation, Logic Operation and Branch Operation; Introduction to Assembly language program., Assembler Directives, Parameter passing and recursive procedures.

Unit-2 (8 Hrs)
Programming Technique With Additional Instruction: Looping, Counting, Indexing, Additional data Transfer and 16 bit Arithmetic instruction, Counters and time delays, Stack and Subroutine.
16 bit Microprocessor: Architecture of 8086- Register Organization, Execution unit, Bus Interface Unit, Signal Description, Physical Memory Organization, Mode of Operation, I/O Addressing Capabilities. Features of Numeric processor 8087,Floating point representation, range resolution, normalization, representation of zero, unused codes, parity bit and error detection.

Unit-3 (7 Hrs)
Basic of Interfacing: Programmed I/O, Interrupt driven I/O, DMA(8257), Parallel I/O (8255-PPI), Serial I/O(8251/8250, RS-232 standard)8259Programmable Interrupt Controller, 8237-DMA Controller, 8253/8254 Programmable Timer/Counter,(8279) Keyboard and display interface, ADC and DAC interfacing

Unit-4 (8 Hrs)
Memory and I/O Interfacing: Types of memory, RAM and ROM , Concepts of virtual memory, Cache memory. Advanced coprocessor Architecture-286,486, Pentium
Application: LED, LCD and Keyboard interfacing. Stepper motor interfacing, DC Motor interfacing, Sensor Interfacing.

Unit-5 (6 Hrs)
An Introduction to Microcontroller 8051: The 8051 Architecture, Instruction set, Basic Assembly language programming concept.
Introduction to Risc Processor: ARM microcontrollers Interface design.

Text/ Reference Books:

1. Douglas V.Hall, 8086 Microprocessors Architecture
2. R.S. Gaonker, Microprocessor Architecture: Programming and Applications with the 8085/8080A/ Penram Interational Publishing, 1996.
3. Kenneth J.Ayala, The 8051 Microcontroller, Penram International Publishing.
4. M.A. Mazidi, J.G. Mazidi and R.D. Mckinlay, The 8051 Microcontroller and Embedded Systems: Using Assembly and C, Pearson Education, 2007.
5. Liu Gibson, Microprocessor
6. Ray, A.K. & Burchandi, K.M., Advanced Microprocessors and Peripherals: Architecture, Programming and Interfacing, Tata McGraw Hill.
7. Brey, Barry B., INTEL microprocessors, 4th Ed, Prentice Hall (India).

BEC 452 Microprocessor and its Applications Lab

L-T-P-C
0-0-2-1

Course Outcomes: At the end of the course, students will demonstrate the ability to:

1. Do basic assembly language programming of 8085.
2. Do advance assembly language programming of 8086.
3. Do basic assembly language programming of 8085 for interfacing of peripherals.
4. Do advance assembly language programming of 8086 for interfacing of peripherals.

List of Experiments: Introduction to 8085 Microprocessor

1. Signed and Unsigned binary addition.
2. Signed Multiplication.
3. Signed and Unsigned binary division
4. BCD addition and subtraction.
5. Ascending and Descending.
6. BCD and binary conversion
7. Binary to BCD conversion
8. Programs for 16 bit arithmetic operations for 8086
9. Program for sorting an array for 8086
10. Program for searching for a number or character in a string for 8086
11. Interfacing with seven segment display
12. Interfacing with 8255 in I/O mode and BSR mode
13. Interfacing with 8253
14. Interfacing with ADC/DAC
15. Look up table method for finding the ASCII of an alpha numeric code.
16. Programming using arithmetic, logical and bit manipulation instructions of 8051
17. Program and verify Timer/Counter in 8051.
18. Program and verify interrupt handling in 8051.
19. UART operation in 8051.
20. Interfacing LCD to 8051.
21. Interfacing matrix or keyboard to 8051

BEC 403 Signals and Systems

L-T-P-C
3-1-0-4

Course Outcomes: At the end of this course students will demonstrate the ability to:

1. Understand and classify different types of signals and systems as per their properties.
2. Represent continuous and discrete time signals and systems in time and frequency domain using different transforms.
3. Understanding frequency concepts for analog and digital signals.
4. Get familiarized with the characteristics and applications of Linear Time Invariant Systems for practical applications.
5. Analyze LTI systems using Laplace/Z-Transform. Use of LTI systems for various applications.

Unit-1 (10 Hrs)

Introduction and Classification of signals: Definition of signal and systems, communication and control systems as examples,Continuous time and discrete time signal, Classification of signals as even, odd, periodic and non-periodic, deterministic and non-deterministic, energy and power.

Elementary signals : reasons for using standard test signals, exponential, sine, impulse, step and its properties, ramp, rectangular, triangular, signum, sinc.

Operations on signals: Amplitude scaling, addition, multiplication, differentiation, integration (Accumulator for DT), time scaling, time shifting and time folding.

Systems: Definition, Classification: linear and non-linear, time variant and invariant, causal and non- causal, static and dynamic, stable and unstable, invertible.

Unit-2 (8 Hrs)

Time domain representation of LTI System: System modeling: Input-output relation, definition of impulse response, convolution sum, convolution integral, computation of convolution integral using graphical method for unit step to unit step, unit step to exponential, exponential to exponential, unit step to rectangular and rectangular to rectangular only. Computation of convolution sum. Properties of convolution. System interconnection, system properties in terms of impulse response, step response in terms of impulse response.

Unit-3 (7 Hrs)

Fourier Series: Fourier series (FS) representation of periodic Continuous Time (CT) signals, Dirichlet condition for existence of Fourier series, orthogonality, Amplitude and phase response, FS representation of CT signals using trigonometric and exponential Fourier series. Applications of Fourier series, properties of Fourier series and their physical significance, Gibbs phenomenon, Discrete Time Fourier Series, properties, convergence of DTFS.

Unit-4 (8 Hrs)

Fourier Transform: Fourier Transform (FT) representation of aperiodic CT signals, Dirichlet condition for existence of Fourier transform, evaluation of magnitude and phase response, FT of standard CT signals, FT of standard periodic CT signals, Properties and their significance, Interplay between time and frequency domain using sinc and rectangular signals, introduction to Discrete Time Fourier Transform and sampling Theorem.

Unit-5 (8 Hrs)

Laplace Transform: Definition of Laplace Transform (LT), Limitations of Fourier transform and need of Laplace transform, ROC, Laplace transform of standard periodic and aperiodic functions, properties of Laplace transform and their significance, Laplace transform evaluation using properties, Inverse Laplace transform based on partial fraction expansion, stability considerations in S domain, Application of Laplace transforms to the LTI system analysis and difference equation with zero initial condition.

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Introduction to Z transform: Region of convergence, properties of the Z transform, Inverse transform using counter, integration, complex convolution theorem, Parseval's relation. Unilateral Z transform and its application to difference equation with zero initial condition.
Introduction to Correlation: Autocorrelation, Cross correlation, and their properties.

Text/Reference Books:

1. Simon Haykins and Barry Van Veen, Signals and Systems, 2nd Edition, Wiley India.
2. Charles Phillips, Signals, Systems and Transforms, 3rd Edition, Pearson Education.
3. A.V. Oppenphim, A.S.Willsky and S.H.Nawab; Signals and Systems, Prentice Hall.
4. B.P. Lathi, Signal and Sytem, Oxford university press , New Delhi.
5. M.J. Roberts, Signal and Systems, Tata McGraw Hill, 2007.
6. Shaila Apte, "Signals and Systems-principles and applications", Cambridge University press, 2016.
7. Mrinal Mandal and Amir Asif, Continuous and Discrete Time Signals and Systems, Cambridge University Press, 2007.
8. Peyton Peebles, Probability, Random Variable, Random Processes, 4th Edition, Tata McGraw Hill.
9. Nagoor Kanni, Signals and Systems, 2nd edition, McGraw Hill.
10. NPTEL video lectures on Signals and Systems

BCS 404 JAVA

L-T-P-C
3-0-0-3

Course Outcomes: After completing this course the student must demonstrate the knowledge and ability to:

1. Able to understand the use of OOPs concepts.
2. Able to understand the use of abstraction, object, class.
3. Able to understand the concept of Inheritance and Polymorphism as well as packages and Interfaces
4. Able to design GUI based applications and develop applets for web applications.
5. Able to develop and understand exception handling, multithreaded applications with synchronization, use of collection and framework

Unit-1 (7 Hrs)
Introduction to Java: Basics of Java programming, Data types, Variables, Operators, Control structures including selection, Looping, Java methods, Overloading, Math class, Arrays in java.

Unit-2 (6 Hrs)
Objects and Classes: Basics of objects and classes in java, Constructors, Finalizer, Visibility modifiers, Methods and objects, Inbuilt classes like String, Character, StringBuffer, File, this reference.

Unit-3 (8 Hrs)
Inheritance and Polymorphism: Inheritance in java, Super and sub class, Overriding, Object class, Polymorphism, Dynamic binding, Generic programming, Casting objects, Instance of operator, Abstract class, Interface in java, Package in java, UTIL package.

Unit-4 (8 Hrs)
Event and GUI programming: Event handling in java, Event types, Mouse and key events, GUI Basics, Panels, Frames, Layout Managers: Flow Layout, Border Layout, Grid Layout, GUI components like Buttons, Check Boxes, Radio Buttons, Labels, Text Fields, Text Areas, Combo Boxes, Lists, Scroll Bars, Sliders, Windows, Menus, Dialog Box, Applet and its life cycle, Introduction to swing.

Unit-5 (6 Hrs)
Multithreading in Java and I/O programming: Text and Binary I/O, Binary I/O classes, Object I/O, Random Access Files. Thread life cycle and methods, Runnable interface, Thread synchronization, Exception handling with try-catch-finally, Collections in java, Introduction to JavaBeans and Network Programming.

Text/Reference Books:

1. Introduction to Java Programming (Comprehensive Version), Daniel Liang, Seventh Edition, Pearson.
2. Programming in Java, Sachin Malhotra & Saurabh Chaudhary, Oxford University Press.
3. Murach's Beginning Java 2, Doug Lowe, Joel Murach and Andrea Steelman, SPD.
4. Core Java Volume-I Fundamentals, Eight Edition, Horstmann& Cornell, Pearson Education.
5. The Complete Reference, Java 2 (Fourth Edition), Herbert Schild, TMH.
6. Java Programming, D. S. Malik, Cengage Learning.

BCS 454 JAVA Lab

L-T-P-C
0-0-2-1

Course outcomes: The student is expected to have hands on experience with the following:

1. Basics of Java programming, multi-threaded programs and Exception handling
2. The skills to apply OOP in Java programming in problem solving
3. Use of GUI components (Console and GUI based)

List of experiments:

1. Program to define a structure of a basic JAVA program.
2. Program to define the data types, variable, operators, arrays and control structures.
3. Program to define class and constructors. Demonstrate constructors.
4. Program to define class, methods and objects. Demonstrate method overloading.
5. Program to define inheritance and show method overriding.
6. Program to demonstrate Packages.
7. Program to demonstrate Exception Handling.
8. Program to demonstrate Multithreading.
9. Program to demonstrate I/O operations.
10. Program to demonstrate Network Programming.
11. Program to demonstrate Applet structure and event handling.
12. Program to demonstrate Layout managers.

MC 301/ MC 401 Environment and Ecology

L-T-P-C
2-0-0-0

Unit-1 (7 Hrs)

Nature of Environment Introduction to Environmental Science - Definition and scope and need for public awareness Ecosystems Concept, structure and functions, restoration of damaged ecosystems Biodiversity – Definition, description at national and global level, threats and conservation Natural Resources - Renewable and non-renewable and their equitable use for sustainability, Material cycles – carbon, nitrogen and sulphur cycle. Conventional and Non-conventional Energy Sources – fossil fuel-based, hydroelectric, wind, -nuclear and solar energy, biomass, biodiesel, hydrogen as an alternative fuel

Unit-2 (7 Hrs)

Impact of Human Activity on Environment Human Population and Environment – Population growth, population explosion and migration; Impact of farming, housing, mining, transportation and industrial growth Social Issues Related to Environment– Sustainable development, urban problems (related to water and energy conservation and waste management), resettlement and rehabilitation Environmental ethics.

Unit-3 (7 Hrs)

Environmental Changes and Human Health Environmental Pollution–Definition, causes and effects, control measures for water, air, soil, marine, land, noise, thermal pollution, Climate change– Greenhouse effect and global warming, acid rain, ozone layer formation and depletion Impact on human health – water and air borne diseases, diseases induced by residual impurities in drinking water (fluoride and arsenic); Toxic wastes and carcinogens; Nuclear hazards.

Unit-4 (7 Hrs)

Environmental Protection through Assessment and Education Indicators and Impact Assessment – Bio-indicators, Natural disasters and disaster management, Impact assessment through inventorying and monitoring Environmental Protection– Role of individuals, organizations and government in pollution control Laws, Conventions and Treaties–National legislation, issues in the enforcement of environmental legislation, initiatives by non- governmental organizations, global efforts in environmental protection Environmental education–women and value education Recommended

Text/Reference Books

1. Environmental Studies, J Krishnawamy , R J Ranjit Daniels, Wiley India.
2. Environmental Science, Bernard J. Nebel, Richard T. Right, 9780132854467, Prentice Hall Professional, 1993.
3. Environment and Ecology, R K Khandal, 978-81-265-4277-2, Wiley India.
4. Environmental Science, 8th Ed ISV, Botkin and Keller, 9788126534142, Wiley India.
5. Environmental Studies, R Rajagopalan, 978-0195673937, Oxford University Press
6. Textbook of Environmental Science and Technology, M.Anjireddy, BS Publications
7. Environmental Studies, Soli. J Arceivala, Shyam, R Asolekar, 9781259006050, McGrawHill India, 2012.
8. Environmental Studies, D.L. Manjunath, 9788131709122 Pearson Education India, 2007
9. Textbook of Environment Ecology, Singh, Acme Learning
10. Perspective in Environmental Studies, Kaushik, New Age International
11. Environmental Studies, B. Joseph, 2nd Ed, 978-0070648134, Tata McGraw Hill

BEC451 PCB DESIGN LAB

L-T-P-C
0-0-2-1

Course Outcomes: At the end of the course, students will be able to:

1. Understand the basic concepts and principles to measure the different electrical signals.
2. Understand the operation and characteristics of different electrical instruments used around them
3. Understand and design the printed circuit boards.
4. Able to do the wiring with the meter in the main line efficiently

List of Experiments:

1. Study of CRO, DMM & Function Generator.
2. Study of various types of Active & Passive Components based on their ratings.
3. Winding shop: Step down transformer winding of less than 5VA.
4. Soldering shop: Fabrication of DC regulated power supply
5. Identification of various types of Printed Circuit Boards (PCB) and soldering Techniques.
6. Introduction to PCB Design software
7. PCB Lab: a.) Artwork & printing of a simple PCB. b.) Etching & drilling of PCB.
8. Wiring & fitting shop: Fitting of power supply along with a meter in cabinet.

BHSM 501 Economics for Industry

L-T-P-C
3-0-0-3

Course outcome: At the end of the course, the students will be able to

1. Define the main concepts and describe the models and methods in economic analysis
2. Explain economic events in individual markets and the aggregate economy using basic theory and tools
3. Apply supply and demand analysis to relevant economic issues
4. Explain how individual decisions and actions as a member of society affect the economy locally, nationally and internationally
5. Distinguish between perfect competition and imperfect competition and explain the welfare loss in non-competitive markets

Unit 1

Introduction of Engineering Economics and Demand Analysis: Meaning and nature of Economics, Relation between science, engineering, technology and economics; Meaning of Demand, Determinants of Demand, Shifts in demand, Law of Demand, Price Elasticity of Demand &Types, Income Elasticity, Cross price Elasticity, Determinants of Elasticity, uses and importance of elasticity.

Unit 2

Concept of Supply: Law of Supply, Factors affecting Supply, Elasticity of supply.

Demand Forecasting: Introduction, Meaning and Forecasting, Methods or Techniques of Demand Forecasting, Criteria for Good Demand Forecasting, Demand Forecasting for a New Product.

Unit-3

Cost Analysis: Introduction, Types of Costs, Cost-Output Relationship: Cost Function, Cost-Output Relationships in the Short Run, and Cost-Output Relationships in the Long Run; Short run and long run, Break-Even Analysis; Production functions: laws of variable proportions, law of returns; Economies of scale: Internal and external.

Unit-4

Market Structure: Market Structure Perfect Competition, Imperfect competition – Monopolistic, Oligopoly, duopoly sorbent features of price determination and various market conditions.

Unit-5

Nature and characteristics of Indian economy, concepts of LPG, elementary concepts of National Income, Inflation and Business Cycles, Concept of N.I. and Measurement., Meaning of Inflation, Types and causes , Phases of business cycle. Investment decisions for boosting economy (National income and per capital income)

Text/References Books:

1. Premvir Kapoor, Sociology and Economics for Engineers, Khanna Publishing House (Edition 2018)
2. Salvatore D, “Principles of Microeconomics”, Oxford University Press.
3. Koutsoyiannis A, “Modern Microeconomic”, Macmillan Education Ltd.
4. Dwivedi DN, “Principles of Microeconomics”, Pearson Education.
5. Cowell, FA, “Microeconomic Principles and Analysis”, Oxford University Press.

BEC 501 Antenna & Wave Propagation

L-T-P-C
3-0-0-3

Course Outcomes: At the end of the course, students will demonstrate the ability to:

1. define various antenna parameters.
2. understand the various special antennas with their applications.
3. understand the reflector antennas & types of reflector antennas.
4. understand the various antenna parameter measurements & antenna arrays.
5. discuss radio wave propagation.

Unit-1 (8 Hrs)

Antenna Fundamentals: Introduction to Antenna, Antenna Types, Antenna Parameters, Power Density, Radiation Intensity, Radiation Pattern, Antenna Directivity, Antenna Gain, Antenna Effective Area (Apertures), Relation between Power Gain & Directive Gain, Plane Angle & Solid Angle, Antenna Band Width, Antenna Beam Width, HPBW(Half Power Beam Width), BWFN(Beam Width First Null), Beam Efficiency, Radiation Resistance & Loss Resistance, Antenna Efficiency, Radio Communication Link (FRISS Transmission Formula), Single-to-Noise Ratio(SNR), Front-to-Back Ratio(FBR), Antenna Noise Figure(F)

Unit-2 (8 Hrs)

Special Antennas: Classification of Antennas, Radio Spectrum Bands, Directional & Non directional Antennas, Omni directional Antenna as a Reference Antenna, Mono pole Antenna, Dipole Antenna, Half Wave or Hertz Antenna, Quarter Wave or Marconi Antenna, Folded Dipole Antenna, Yagi-Uda Antenna, Loop Antenna, Horn Antenna, Helical Antenna with their Construction, Operation, Advantages, Disadvantages and Applications

Unit-3 (8 Hrs)

Reflector & Dish Antennas: Introduction, Need of Reflector Antennas, Types of Reflector Antennas, Flat Sheet Reflectors, Corner Reflectors, Dish (Parabolic) Reflector Antennas, Comparison Between Parabolic and Corner Reflector Antennas, Feed Methods for Reflector Antennas, Applications of Reflector Antennas

Unit-4 (8 Hrs)

Antenna Measurements: Introduction, Test Antenna, Reference Antenna, Antenna Parameters Measurement Setup, Antenna Range Measurement, Antenna Radiation Pattern Measurement, Antenna Gain Measurement

Antenna Arrays: Introduction, Need of Antenna Arrays, Types of Antenna Arrays, Applications of Antenna Arrays

Unit-5 (8 Hrs)

Radio Wave Propagation: Introduction to Radio Wave Propagation, Structure of Atmosphere, Different Regions & Layers of Atmosphere, Different Modes of Propagation, Ground wave propagation, Space wave propagation, LOS propagation, Applications, Sky wave propagation, Structural of the Ionosphere, Wave Propagation Mechanism, Refraction and Reflection of Sky Waves by Ionosphere, Critical Frequency, MUF, LUF, Virtual Height, Skip Distance, Relation Between MUF and Skip Distance, Multi-Hop Propagation, Characteristics of different Layers of Ionosphere

Text/ Reference Books:

1. J. D. Krauss, "Antennas", TMH Publication.
2. K. D. Prasad, "Antenna and Wave Propagation", Pragati Prakashan.
3. A. R. Harish, M. Sachidananda, "Antennas and Wave Propagation", Oxford University Press.
4. R.E. Collin, "Antennas and Radio wave Propagation", Mc Graw Hill.

BEC 502 Automatic Control Systems

L-T-P-C
3-0-0-3

Course Outcomes: After the successful completion of the course the students will be able to:

1. develop the mathematical model of the physical systems.
2. analyze the response of the closed and open loop systems.
3. analyze the stability of the closed and open loop systems.
4. Understanding the concept of gain margin and phase margin.
5. develop and analyze state space models

Unit-1 (8 Hrs)

Control System And Their Representation: Terminology and basic structure of control system, Open loop and Closed loop systems, analogous systems. Physical Systems and their models, Electromechanical systems, electrical analogy of physical systems. Transfer function, Block diagram representation of physical systems, Block diagram algebra, Signal Flow graph and Mason's formula.

Unit-2 (7 Hrs)

Time Response: Types of test inputs, Response of first and second order system, Time domain specifications, Static and Dynamic Error coefficients

Stability: Concepts of stability, location of roots in s-plane for stability, asymptotic stability and relative stability, Routh-Hurwitz stability criterion.

Unit-3 (8 Hrs)

Root Locus: Root locus plot, Properties of Root loci and applications, Stability range from the loci. Determination of roots of the closed loop system, Effect of pole zero addition

Nyquist Plots: Polar plots, Nyquist plots and Nyquist stability criterion

Unit-4 (7 Hrs)

Bode Plots: Concepts of Gain margin and phase margin, Bode plots Frequency-domain specifications.

Unit-5 (8 Hrs)

Controllers: Introduction to PID and Lag-lead type Controllers

State Variable Analysis: Concepts of state, state variable and state model. State variable models for LTI systems. Canonical representations, Transfer function to state-space and vice-versa. Solution to state equations. Concepts of controllability & observability.

Compensation Design: compensation design using frequency domain techniques.

Text/ Reference Books:

1. KUO B.CI Automatic control system/Pill.
2. Ogata Kj Modern Control Engineering / PHI.
3. Nagrath I.J. &Gopal, M/Control Systems Engineering/New Age International.
4. S.N. Sivanandam/Control Systems Engineering /Vikas Publishing House Pvt. Ltd.
5. Singh &Janardhanan - Modern control engineering, Cengage learning

6. Control Systems,Srivastava,TMH 2009
7. Systems and Control - Stanislawhizak, Oxford
8. Control System Engineering,S. K. Bhattacharya,Pearson
9. Control Systems: Theory And Applications,Ghosh,Pearson

BEC 552 Automatic Control Systems Lab

L-T-P-C
0-0-2-1

Note: The minimum of 10 experiments are to be performed from the following, out of which at least three should be software based.

1. To study P, PI and PID temperature controller for an oven and compare their performance.
2. To study and calibrate temperature using resistance temperature detector (RTD)
3. To design Lag, Lead and Lag-Lead compensators using Bode plot.
4. To study DC position control system
5. To study synchro-transmitter and receiver and obtain output vs input characteristics
6. To determine speed-torque characteristics of an ac servomotor.
7. To study performance of servo voltage stabilizer at various loads using load bank.
8. To study the behaviour of separately excited dc motor in open loop and closed loop conditions at various loads.
9. Software based experiments (Use MATLAB, LABVIEW software etc.)
10. To simulate PID controller for transportation lag.
11. To determine time domain response of a second order system for step input and obtain performance parameters.
12. To convert transfer function of a system into state space form and vice-versa.
13. To plot root locus diagram of an open loop transfer function and determine range of gain ‘k’ fir stability.
14. To plot a Bode diagram of an open loop transfer function.
15. To draw a Nyquist plot of an open loop transfers functions and examine the stability of the closed loop system.

Reference Books:

1. K.Ogata,“Modern Control Engineering” Prentice Hall of India.
2. Norman S.Nise, “Control System Engineering”, John Wiley & Sons.
3. M.Gopal, “Control Systems: Principles & Design” Tata Mc Graw Hill

BEC 503 Electronic Measurement & Instrumentation

L-T-P-C
3-0-0-3

Course Outcomes: At the end of the course, students will demonstrate the ability to:

1. understand the fundamentals & characteristics of measurement & instrumentation.
2. analyze the different types with their applications of sensors and transducer.
3. apply the skills how to use electronic instruments & bridges with their applications.
4. apply the skills how to use display & special devices with their applications.
5. understand the operation, classification & application of telemetry & data acquisition system.

Unit-1 (8 Hrs)

Introduction to Measurement: Measurement system, Methods of measurement, Classification of instrument systems, Characteristics of instruments, Unit, Dimensions, Standards, Scientific notations.

Errors in Measurement: Introduction to Error, Errors in Measurement, Gross error, Systematic error, Absolute error, Relative error, Accuracy, Precision, Resolution, Sensitivity.

Unit-2 (8 Hrs)

Sensors & Transducers: Sensors, Transducers, Definition, Types of transducers, Selection of transducers, Advantages of transducers, Applications of transducers, Characteristics, Factors affecting the choice of transducers, Strain gauges, Resistance Temperature Detector, Load Cell transducers, Linear variable differential transducers, Thermocouple sensors, Piezoelectric transducers, Photoelectric transducers.

Unit-3 (8 Hrs)

Electronic Instruments: Digital multi meter, Digital frequency meter, Voltmeter, Ammeter, Energy meter, Q-meter.

Bridges: Introduction, Types, Balance condition, Applications, Resistance measurement, Measurement of low, medium and high resistances, Wheatstone bridge, AC bridges for inductance measurement, AC bridges for capacitance measurement, Advantages and Applications of bridges in measurement system.

Unit-4 (8 Hrs)

Display Devices: Cathode Ray Oscilloscope (CRO): Block diagram, Cathode Ray Tube (CRT) & its components, Applications of CRO in measurement, Measurement of voltage, frequency and phase by CRO, Types of CRO, Digital Storage Oscilloscope (DSO), Applications of Digital Storage Oscilloscope(DSO), Electronic measurement using Cathode ray oscilloscope(CRO) and Digital storage oscilloscope(DSO).

Special Devices: Spectrum Analyzer, Logic Analyzer, Data Loggers, Digital Read Out Systems, Digital Input devices, Digital Output devices.

Unit-5 (8 Hrs)

Telemetry and Data Acquisition Systems: Introduction to telemetry, Telemetry types, Landline telemetry, Radio telemetry, Telemetry applications, Introduction to Data acquisition systems, Data acquisition systems types, Analog Data acquisition systems and Digital Data acquisition systems, Data acquisition systems applications.

Text/ Reference Books:

1. A.K.Sawhney, "Advanced Measurements & Instrumentation", Dhanpat Rai & Sons
2. Rajendra Prasad, "Electronic Measurement and Instrumentation Khanna Publisher
3. M.M.S. Anand, "Electronic Instruments and Instrumentation Technology" PHI Learning.
4. David A. Bell, "Electronic Instrumentation and Measurements", Oxford University Press.

5. Oliver and Cage, "Electronic Measurements and Instrumentation", Tata McGraw Hill Publication.
6. Alan S. Morris, "Measurement and Instrumentation Principles", Elsevier Buterworth Heinmann.

BEC 553 Electronic Measurement & Instrumentation Lab

L-T-P-C
0-0-2-1

Course Outcomes: At the end of the course, students will demonstrate the ability to:

1. apply the skills how to select the correct sensors & transducers to find unknown values.
2. analyze the different types with their characteristics of sensors and transducer.
3. apply the skills how to use electronic instruments with their applications.
4. apply the skills how to use display devices with their applications.

List of Experiments:

1. To study & observe the characteristics of RTD Sensor.
2. To study & observe the characteristics of Load Cell Sensor.
3. To study & observe the characteristics of LVDT.
4. To study & observe the characteristics of Ultrasonic Sensor.
5. To study & observe the characteristics of Smoke Sensor.
6. To study & observe the characteristics of IR Sensor.
7. To study & observe the characteristics of Thermocouple Sensor.
8. To study & observe the characteristics of NTC Temperature Sensor.
9. To study & observe the characteristics of Humidity Sensor.
10. To study & observe the characteristics of Photo Diode.
11. To study & observe the application of FPGA Trainer Kit.

Text/ Reference Books:

1. A.K.Sawhney, "Advanced Measurements & Instrumentation", Dhanpat Rai & Sons
2. Rajendra Prasad, "Electronic Measurement and Instrumentation Khanna Publisher
3. M.M.S. Anand, "Electronic Instruments and Instrumentation Technology" PHI Learning.
4. David A. Bell, "Electronic Instrumentation and Measurements", Oxford University Press.
5. Oliver and Cage, "Electronic Measurements and Instrumentation", Tata McGraw Hill Publication.
6. Alan S. Morris, "Measurement and Instrumentation Principles", Elsevier Buterworth Heinmann.

BEC 601 Analog Communications

L-T-P-C
3-1-0-4

Course Outcomes: At the end of the course, students will demonstrate the ability to:

1. Acquired knowledge about basic elements of a communication system.
2. design AM systems.
3. design Angle modulated systems.
4. design Pulse modulated systems.

Unit-1 (9 Hrs)

Communication System: Elements of Analog communication System and its Fundamental Limitations, Need of Modulation, Applications of Analog Communication.

Random Processes: Random Process, Stationary Processes, Ergodic Processes, Transmission through LTI, Power spectral density, Gaussian process.

Noise: External and internal sources of noise, Thermal noise, Calculation of thermal noise, Shot noise, Noise figure, Noise temperature, Equivalent noise bandwidth.

Unit-2 (8 Hrs)

Amplitude (Linear Modulation): Generation and detection of Amplitude Modulation, DSB-SC, SSB, VSB, Carrier Acquisition, AM transmitter, AM Receiver, Receiver Characteristics.

Unit-3 (8 Hrs)

Angle (Exponential Modulation): Types of Angle Modulation, Concepts of Instantaneous frequency and Phase, Wideband and Narrowband FM, Generation and detection of FM, Generation and detection of PM. Comparison of AM and FM.

Unit-4 (8 Hrs)

Noise performance of CW Modulation Systems: Noise in DSB-SC, SSB-SC and AM system, Noise in FM and PM, FM threshold and its extension, Pre-emphasis and De-emphasis in FM**,** Concept of TDM and FDM.

Unit-5 (7 Hrs)

Sampling theory & Pulse modulation: Sampling process, sampling theorem, signal reconstruction, flat top sampling of band pass signals, Analog Pulse Modulation: Types of analog pulse modulation, Method of generation and detection of PAM, PWM, PPM, Spectra of pulse modulation.

Text/References Books:

1. Simon Haykin, Communication Systems. John Wiley
2. B.P. Lathi, Modern Analog & Digital Communication. Oxford Univ Press
3. P. chakrabarti, Analog Communication System. Dhanpat Rai
4. Taub & Schilling, Principles of Communication Systems. Tata McGraw-Hill
5. Kennedy, George & Davis, Bernard, Electronic communication systems. Tata McGraw Hill
6. Singh, R.P. & Sapre, S.D., Communication Systems: Analog & Digital. Tata McGraw Hill
7. A.B. Carlson, Communication Systems. Tata McGraw-Hill
8. Carlson, A. Bruce, Crilly, Paul B. & Rutledge, Janet C, Communication Systems an Introduction to Signals & Noise in Electrical Communication. Tata McGraw-Hill

BEC 651 Analog Communications Lab

L-T-P-C
0-0-2-1

Course Outcomes: At the end of the course, students will demonstrate the ability to

1. Generate various AM signals
2. Generate FM signals
3. Evaluate the performances of AM and FM systems
4. Perform signal sampling by determining the sampling rates for baseband signals and reconstruct the signals

List of Experiments:

1. Generation of AM Signal and measurement of Modulation Index.
2. Envelop Detector for AM Signals
3. Generation & Detection of DSB-SC Signal.
4. SSB Generation.
5. To study the Varactor modulator.
6. To study the Reactance modulator.
7. Generation of FM Signal.
8. FM Detector using PLL.
9. To study the analog signal, sampling and reconstruction.

BEC 602 Digital Signal Processing

L-T-P-C
3-1-0-4

Course Outcomes: After studying this course, students will be able to:

1. Determine response of LTI systems using time domain and DFT techniques.
2. Compute DFT of real and complex discrete time signals.
3. Computation of DFT using FFT algorithms and linear filtering approach.
4. Solve problems on digital filter design and realize using digital computations.

Unit-1 (7 Hrs)

Discrete Fourier Transforms (DFT): Frequency domain sampling and reconstruction of discrete time signals. DFT as a linear transformation, its relationship with other transforms. Properties of DFT, multiplication of two DFTs- the circular convolution

Unit-2 (7 Hrs)

Additional DFT properties, use of DFT in linear filtering, overlap-save and overlap-add method. Fast-Fourier-Transform (FFT) algorithms: Direct computation of DFT, need for efficient computation of the DFT (FFT algorithms).

Unit-3 (8 Hrs)

Radix-2 FFT algorithm for the computation of DFT and IDFT–decimation-in-time and decimation-in-frequency algorithms. Goertzel algorithm, and chirp-z transform.

Unit-4 (6 Hrs)

IIR filter design: Characteristics of commonly used analog filter – Butterworth and Chebyshev filters, analog to analog frequency transformations.
Design of IIR Filters from analog filter using Butterworth filter: Impulse invariance, Bilinear transformation.

Unit-5 (8 Hrs)

Structure for FIR Systems: Direct form, Linear Phase, Frequency sampling structure, Lattice structure. FIR filter design: Introduction to FIR filters, design of FIR filters using Rectangular, Hamming, Hanning and Bartlett windows.

Text/ Reference Books:

1. Discrete Time Signal Processing, Oppenheim & Schaffer, PHI, 2003.
2. Digital Signal Processing, S. K. Mitra, Tata Mc-Graw Hill, 3rd Edition, 2010.
3. NPTEL video lectures.

BEC 652 Digital Signal Processing Lab

L-T-P-C
0-0-2-1

Course Outcomes: After studying this course, students will be able to:

1. Describe sampling thorem in MATLAB
2. Understand and verify different system properties
3. Find DFT and its Inverse DFT
4. Design FIR filter in MATLAB using window method
5. Design IIR filter in MATLAB.

List of experiments:

1. Study of Sampling theorem, effect of under sampling.
2. Study of Quantization of continuous - amplitude, discrete- time analog signals.
3. Study of different types of Companding Techniques.
4. Study of properties of Linear Time- Invariant system.
5. Study of Convolution: Series and Parallel system.
6. Study of Discrete Fourier Transform (DFT) and its inverse.
7. Study of Transform domain properties and its use
8. Study of FIR filter design using window method: Lowpass and highpass filter.
9. Study of FIR filter design using window method: Bandpass and Bandstop filter.
10. Study of Infinite Impulse Response (IIR) filter.

Text/Reference Books:

1. Digital Signal Processing, Lee Tan: Elsevier publications, 2007

BEC 603 Linear Integrated Circuits

L-T-P-C
3-1-0-4

Course Outcomes: At the end of the course, students will demonstrate the ability to:

1. analyze and design analog circuits such as: differential amplifier, Op-amp and current mirror.
2. analyze and develop skill to design circuits such Op-amp circuit as comparator Schmitt trigger precision rectifier peak detector circuit, integrator circuit, difference circuit square wave and triangular wave generator etc.
3. understand the concept of filters & oscillators develop to design various filter and oscillator circuit.
4. know about various type of techniques to develop A/D and D/A convertors.
5. understand the basics of timer IC 555 and phase locked loop, its working concept.

Unit – 1 (7 Hrs)

Op-Amp Basics: Introduction, Differential amplifier configurations, DC & AC analysis of all Differential amplifier configurations, swamping resister, constant current bias, current mirror circuits, level translator, Block diagram of op-amp, op-amp-internal circuit, op-amp characteristics, voltage series and voltage shunt feedback amplifier.

Unit – 2 (7 Hrs)

Inverting/Non-inverting amplifier, voltage follower, summing, averaging, scaling amplifier, difference amplifier, ideal Integrators, practical integrator with frequency response, ideal Differentiators, practical differentiator with frequency response, instrumentation Amplifiers, filters, Oscillators. Logarithmic amplifiers, Precision rectifier, peak detector, sample and hold circuits. OP – AMP as comparator, Schmitt trigger, clipper and clamper, square and triangular wave generator, Multi-vibrator: monostable, astable and bistable.

Unit – 3 (6 Hrs)

Filter & Oscillators: Types of filter(LP, HP, BP and Notch), first order and second order low-pass and high-pass butterworth filter, filter design, frequency scaling Oscillator principal, types and frequency stability, design of phase shift, wein bridge, quadrature,voltage controlled oscillator.

Unit – 4 (8 Hrs)

Voltage Regulators &Data Converters: Transistorized series-pass Regulator, Overload short circuit and Thermal shut-down protection fixed voltage regulators (78/79, XX), 723 IC Regulators (Current limiting, Current fold back); SMPS.

DAC: types of DAC, weighted resistor, R2R ladder ADC: types of ADC, Flash type, counter type, successive approximation resistor.

Unit – 5 (7 Hrs)

Signal generators and wave shaping circuits: IC timer (555) , internal structure, pin diagram, monostable and astable operation PLL: 565 phase locked loop, block diagram of PLL, and its function, VCO, phase detector, applications of PLL,FM demodulation using PLL

Text/ Reference Books:

1. Sedra Smith Microelectronics/Oxford Universities Press.
2. Gayakwad/OP Amps and Linear Integrated circuits/PHI.
3. D. Roy Choudhary, sheil B Jain, Linear integrated circuits, New Age Publishers, 2010.

1. C.S. Soclof/Application of analog Integrator circuits/PHI.
2. D. P. Singh /semiconductor devices and circuits /Dhanpat Rai & Co.
3. Jacob applications & Design with analog Ics/PHI 1996.

BEC 653 Linear Integrated Circuits Lab

L-T-P-C
0-0-2-1

Course Outcomes: At the end of the course, students will demonstrate the ability to:

1. design and implement an inverting and non- inverting amplifier circuit.
2. design and implement a summing amplifier difference amplifier, a differentiator and an integrator circuit.
3. design and implement RC and LC oscillator.
4. know about and design square wave generator to operate at frequency f_o=500H.
5. know about timer-555 operation as monostable and astable multivibrator.

List of Experiments:

1. To design and implement an inverting amplifier circuit.
2. To design and implement a non- inverting amplifier circuit.
3. To design and implement a summing amplifier circuit.
4. To design and implement a difference amplifier circuit.
5. To design and implement a differentiator circuit.
6. To design and implement an integrator circuit.
7. To design and implement RC oscillator.
8. To design and implement LC oscillator.
9. To study and design square wave generator to operate at frequency f_o=500H.
10. To study timer-555 as monostable and astable multivibrator.

OHS 601 Occupational Health & Safety

L-T-P-C
2-0-0-0

Course Outcome: After learning the course the students should be able to:

1. Identify the diseases associated with occupation.
2. Manage safety in industries by suggesting safety measures.
3. Identify the accidental causes & apply the preventions.
4. Identify Fire Explosion & apply PPE.
5. Identify & apply Hazards & Risk identification, Assessment and control techniques.

Unit-1

Occupational Health: Classification of occupational health hazards, dangerous properties of chemical and their health effects, routes of entry of toxic material into human body, permissible exposure limits, Threshold limit value, lethal dose and lethal concentration, Ergonomics, constituents of ergonomics, application of ergonomics for safety & health, occupational diseases due to metals & dusts, fumes & chemical compounds.

Unit-2

Safety: Concept, Philosophy & Psychology of safety: Concept of safety, Nature of concept of safety, Philosophy of safety, safety terminology, philosophy of total safety concept, safety psychology, accident causative factors, general psychological factors

Unit-3

Accident Causes and prevention: Causation, Accident problem, Reasons for prevention, factors impending safety, Accident prevention

Safety Management: Concept of management, element of management, functions, management principles, safety management & its responsibilities, safety Organization

Electrical Safety: Electricity and Hazardous, Indian standards, effects of electrical parameters on human body, safety measures for electric works

Unit-4

Fire and Explosion: Fire phenomena, classification of fire and extinguishers, statutory and other standards, fire prevention & protection system, explosion phenomena, explosion control devices, fire awareness signs

Personal Protective Equipment: Need of PPE, Indian standards, factors of selection of PPE, non respiratory equipments, respiratory equipments.

Unit-5

Hazards & Risk identification, Assessment and control techniques: Hazards, Risks & detection techniques, Preliminary hazard analysis(PHA) & hazard analysis(HAZAN), failure mode effect analysis(FMEA), Hazard and operability(HAZOP) study, Hazard ranking (DOW & MOND index), Fault tree analysis, Event tree analysis(ETA), major accident hazard control, on-site and off-site emergency plans. Safety in different industries as case study.

BEC 701 Digital Communications

L-T-P-C
3-0-0-3

Course Outcomes: After the completion of the course the student will be able to:

1. Model a digital communication system and Identify source coding and channel coding schemes for Digital communication link
2. Understand the wave form coding techniques and evaluate the performance of PCM, DPCM and DM in a digital communication system
3. Comparison of various digital modulation techniques.
4. Design encoder and decoder schemes for error control.

Unit-1 (9 Hrs)

Elements of Digital communication and information theory: Model of a digital communication system ; logarithmic measure of information, entropy and information rate, conditional entropy and redundancy, source coding fixed and variable length code words, Source coding theorem, prefix doing and craft inequality, Shannon–fano and Huffman coding, maximum entropy of a continuous source (with Gaussian distribution) entropy of a band limited white Gaussian noise, Mutual information and channel capacity of a discrete memory less channel of a BSC, Hartley Shannon law.

Unit-2 (8 Hrs)

Waveform coding techniques: Discretization in time and amplitude, Linear quantizer, quantization noise power calculation, signal to quantization noise ratio, non–uniform quantizer, A law & μ law companding; encoding and pulse code modulation, bandwidth of PCM, Differential pulse code modulation, Delta modulation, Idling noise and slope overload, Adaptive delta modulation, adaptive DPCM. Comparisonof PCM and DM.

Digital multiplexing: Fundamentals of time division multiplexing, electronic commutator, bit, byte interleaving E1 Carrier system, Synchronization and signaling of E1, TDM, PCM hierarchy.

Unit-3 (8 Hrs)

Digital Baseband transmission: Line coding and its properties. NRZ & RZ types, signaling format for Unipolar, polar, bipolar, AMI & Manchester coding and their power spectra (No derivation), HDB and B&W signaling, ISI, Nyquist criterion for zero ISI & raised cosine spectrum. Matched filter receiver, derivation of its impulse response and peak pulse signal to noise, correlation detector decision threshold and error probability for binary Unipolar (on – off), signaling.

Unit-4 (8 Hrs)

Digital modulation techniques: Types of digital modulation, wave forms for amplitude, frequency and phase shift keying. Method of generation and detection of coherent & non–coherent binary ASK, FSK & PSK, differential phase shift keying, Quadrature modulation techniques (QPSK and MSK) probability of error and comparison of various digital modulation techniques**.**

Unit-5 (9 Hrs)

Error control coding: Error free communication over a noisy channel, Hamming sphere, hamming distance and hamming bound, relation between minimum distance and error detecting and correcting capability, linear block codes, encoding & syndrome decoding; cyclic codes, encoders and decoders for systematic cycle codes; convolutional codes, code tree & Trellis diagram, Viterbi and sequential decoding, burst error correction.

Text/References:

1. Simon Haykin, Communication Systems. John Wiley
2. B.P. Lathi, Modern Analog & Digital Communication. Oxford Univ Press
3. B.Sklar, Digital Communications, 2nd Edition, Pearson Education, New Delhi, 2009.
4. P. chakrabarti, Analog Communication System. Dhanpat Rai
5. Taub & Schilling, Principles of Communication Systems. Tata McGraw-Hill
6. Kennedy, George & Davis, Bernard, Electronic communication systems. Tata McGraw Hill
7. Singh, R.P. & Sapre, S.D., Communication Systems: Analog & Digital. Tata McGraw Hill
8. A.B. Carlson, Communication Systems. Tata McGraw-Hill
9. Carlson, A. Bruce, Crilly, Paul B. & Rutledge, Janet C, Communication Systems an Introduction to Signals & Noise in Electrical Communication. Tata McGraw-Hill

BEC 751 Digital Communications Lab

L-T-P-C
0-0-2-1

Course Outcomes: After the completion of the course the student will be able to:

1. Perform signal sampling for baseband signals and reconstruct the signals.
2. Generate digital modulation signals for ASK, PSK and FSK and perform their detection.
3. Understand and generate QPSK signal.
4. Single bit error detection and correction.

List of Experiments:

1. Sample and hold circuit.
2. ASK, FSK, PSK modulation and detection
3. PCM Modulation and detection
4. PAM, PWM, PPM generation and detection.
5. QPSK Generation
6. Pulse data coding and decoding techniques for NRZ formats
7. Delta modulation and detection.
8. Single bit error detection and correction.

BEC 702 Wireless & Mobile Communication

L-T-P-C
3-0-0-3

Course Outcomes: After the completion of the course the student will be able to:

1. Demonstrate their understanding on functioning of wireless communication system and evolution of different wireless communication systems and standards.
2. Compare different technologies used for wireless communication systems.
3. Explain the architecture, functioning, protocols, capabilities and application of various wireless communication networks.
4. Demonstrate an ability explain multiple access techniques for Wireless Communication
5. Demonstrate an ability to evaluate design challenges, constraints and security issues associated with Ad-hoc wireless networks.

Unit-1 (7 Hrs)

Evolution of mobile radio communication fundamentals: General Model of Wireless Communication Link, Types of Signals, Cellular Infrastructure, Cellular System Components, Antennas for Cellular Systems, Operation of Cellular Systems, Channel Assignment, Frequency reuse, Channel Assignment strategies, Handoff Strategies Cellular Interferences, Sectorization; Wireless Channel and Radio Communication, Free Space Propagation Model, Channel Noise and Losses, Fading in Land Mobile Systems, Multipath Fading, Fading Effects on Signal and Frequency.

Unit-2 (7 Hrs)

Theory of Vocoders, Types of Vocoders; Spread Spectrum Modulation, Pseudo-Noise Codes with Properties and Code Generation Mechanisms, DSSS and FHSS Systems, Time Hopping and Hybrid Spread Systems; Multicarrier Modulation Techniques, Zero Inter Symbol Interference Communication Techniques, Detection Strategies, Diversity Combining Techniques: Selection Combining, Threshold Combining, Equal Gain Combining, Maximum Ratio Combining; Spatial Diversity and Multiplexing in MIMO Systems, .

Unit-3 (8 Hrs)

Equalization Techniques: Transversal Filters, Adaptive Equalizers, Zero Forcing Equalizers, Decision Feedback Equalizers, and related algorithms; Multiplexing and Multiple Access: FDMA, TDMA, CDMA, OFDMA, SCFDMA, IDMA Schemes and Hybrid Method of Multiple Access Schemes, RAKE Receiver; Multiple Access for Radio Packet Systems.

Unit-4 (6 Hrs)

GSM system for mobile Telecommunication, General Packet Radio Service, Edge Technology; CDMA Based Standards: IS 95 to CDMA 2000, Wireless Local Loop, IMT 2000 and UMTS, Long Term Evolution (LTE), Mobile Satellite Communication.

Unit-5 (8 Hrs)

Introduction to Mobile Adhoc Networks, Bluetooth, Wi-Fi Standards, WiMax Standards, Li-Fi Communication, Ultra-Wideband Communication, Mobile data networks, Wireless Standards IMT 2000, Introduction to 4G and concept of NGN.

Text/ Reference Books:

1. T.S. Rappaport, "Wireless Communication-Principles and practice", Pearson Publications, Second Edition.
2. Upena Dalal, "Wireless Communication and Networks", Oxford Press Publications.
3. T L Singal ,"Wireless Communications ", McGraw Hill Publications
4. NEPTL Lecture.

BEC 752 Wireless & Mobile Communication Lab

L-T-P-C
0-0-2-1

Course Outcomes: At the end of the course, students will demonstrate the ability to:

1. Describe the evolution of mobile communication system.
2. Describe the various concept of cellular system.
3. Illustrate the various models of propagation in mobile communication.
4. Express the equalization & channel coding for various system.
5. Compare the different wireless networks &standards.
6. Set up experiments for wireless mobile communication.

List of experiments:

1. To understand the Basic circuit of Mobile phone (Transmitter, Receiver and Base band control Section).
2. To study working of SIM card in GSM handset SIM card detection.
3. To Study and observe Transmitted/Received RF signal.
4. Study and observe Transmitted (I & Q) /Received (I & Q) signals constellations.
5. Study and analyze the Buzzer in 4G LTE Smart Phone Tech Book.
6. To study and Analyze the Vibrator in 4G LTE smart phone Tech book
7. Study of switch faults in User Interface Section of 4G LTE Smart PhoneTechBook
8. Study and analyze the Power Management Unit in 4G LTE Smart Phone TechBook
9. To study AT commands using GSM trainer module
10. To study General Packet Radio Receiver

Text/Reference Books:

1. Andrea Goldsmith, “Wireless Communications”, Cambridge University Press.
2. Haykin& M. Moher, “Modern wireless communication”, Pearson

BEC 801 Optical Communications

L-T-P-C
3-0-0-3

Course Outcomes: At the end of the course, students will demonstrate the ability to:

1. familiarize with basic concepts and theory of optical fiber communication system.
2. learn transmission characteristics of optical fiber in optical fiber communication system.
3. understand the various optical sources used in optical fiber communication system.
4. understand the various optical receivers used in optical fiber communication system.
5. understand optical link design in optical fiber communication system.

Unit-1 (8 Hrs)

Overview of optical fiber communication: Block diagram of optical fiber communication system, advantage of optical fiber communication, transmission link, basic structure of optical fiber, light propagation in optical fiber using ray theory transmission, total internal reflection, acceptance angle, numerical aperture, optical fiber modes, step index, graded index fiber, fiber materials, fiber fabrication.

Unit-2 (8 Hrs)

Transmission characteristics of optical fiber: Introduction, attenuation , absorption losses, scattering losses, bending losses, distortion in optical fiber communication system, optical power launching, coupling, power calculation, fiber to fiber joints, fiber splicing technique, fiber connectors.

Unit-3 (8 Hrs)

Optical sources: LASER: Basic concepts of laser, Semiconductor injection laser (ILD), Characteristics of Injection laser, Advantage of LASER, Applications of LASER.
LED: LED structures, LED power and efficiency, LED characteristics, LED advantages, LED applications.

Unit-4 (8 Hrs)

Optical detectors: Requirement for photo detections p-n photodiode, advantages of p-n photodiode, characteristics of photo detections, avalanche photodiodes, phototransistors, Performance considerations, Noise in optical receiver, Optical Power meter.

Unit-5 (8 Hrs)

Optical link design: Point to point link, system considerations, link power budget, rise time budget, modulation formats for optical communication system, introduction to WDM concepts, multiplexing strategies in optical fiber.

Text/ Reference Books:

1. G. Keiser: Optical Fiber Communication – MGH
2. Jenkins & White : Fundamentals Of Optics – MGH
3. J. M. Senior : Optical Fiber Communication – PHI
4. Gagliardi & Karp: Optical Communication – Wiley

BEC 851 Optical Communications Lab

L-T-P-C
0-0-2-1

Course Outcomes: At the end of the course, students will demonstrate the ability to:

1. understand and measure the basic properties of the propagation of light in optical fiber communication system
2. understand the differences between types of light sources utilized in optical fiber communication system
3. understand the differences between types of light receivers utilized in optical fiber communication system
4. understand the different types of modulation techniques used in optical fiber communication system

List of Experiments:

1. To study & observe how Analog Signal can be transmitted through Optical Fiber Cable & reproduced at the receiver end.
2. To study & observe how Digital Signal can be transmitted through Optical Fiber Cable & reproduced at the receiver end.
3. To study & observe Voice Link through Optical Fiber Cable.
4. To measure the power of Optical Fiber Cable using Optical Power Meter.
5. To observe the bending loss in Optical Fiber Cable.
6. To study & observe the Losses (Propagation Loss) in Optical Fiber Cable.
7. To study & perform Amplitude Modulation & Demodulation through Optical Fiber Cable.
8. To study & perform Frequency Modulation & Demodulation through Optical Fiber Cable.
9. To study & perform Pulse Amplitude Modulation & Demodulation through Optical Fiber Cable.
10. To study & perform Pulse Width Modulation and Demodulation through Optical Fiber Cable.
11. To study Pulse Position Modulation and Demodulation through Optical Fiber Cable.
12. To study & observe the Numerical Aperture of Optical Fiber & measure the Numerical Aperture of Optical Fiber Cable.

Text/ Reference Books:

1. G. Keiser: Optical Fiber Communication – MGH
2. Jenkins & White : Fundamentals Of Optics – MGH
3. J. M. Senior : Optical Fiber Communication – PHI
4. Gagliardi & Karp: Optical Communication – Wiley

BEC 802 Satellite Communication

L-T-P-C
3-0-0-3

Course Outcomes: At the end of the course, students will demonstrate the ability to:

1. define orbital mechanics and satellite launch methodology.
2. describe satellite sub systems
3. design link power budget for satellite
4. explain different satellite access
5. describe DTH and Compression standard.

Unit-1 (7 Hrs)

Introduction: frequency allocations for satellite systems. orbits and launching methods: Kepler's three laws of planetary motion, terms used for earth orbiting satellites, orbital elements, apogee and perigee heights, orbit perturbations, inclined orbits, local mean solar point and sun-synchronous orbits, standard time.

Unit-2 (7 Hrs)

The Geostationary orbit: Introduction, antenna look angles, polar mount antenna, limits of visibility, near geostationary orbits, earth eclipse of satellite, sun transit outage, launching orbits. polarization: antenna polarization, polarization of satellite signals, cross polarization discrimination. depolarization: ionospheric, rain, ice.

Unit-3 (8 Hrs)

The Space segment: Power supply, attitude control, station keeping, thermal control, tt&c subsystem, transponders, antenna subsystem, Morelos and Satmex 5, Anik-satellites, advanced Tiros-n Spacecraft. the earth segment, receive-only home TV systems, master antenna tv system, community antenna TV system, transmit-receive earth station.

Unit-4 (6 Hrs)

The space link: Introduction, equivalent isotropic radiated power, transmission losses, the link power budget equation, system noise, carrier-to-noise ratio (C/N), the uplink, the downlink, effects of rain, combined uplink and downlink C/N ratio, inter modulation noise, intersatellite links. interference between satellite circuits.

Unit-5 (8 Hrs)

Satellite Services VSAT systems: Network architecture, access control protocols, basic techniques, VSAT earth station, calculation of link margins for a VSAT star network. direct broadcast satellite television and radio: digital DBS TV, BDS TV system design and link budget, error control in digital DBS-TV, installation of DBS-TV antennas, satellite radio broadcasting.

Text/ Reference Books:

1. Roddy: Satellite Communications, TMH.
2. Timothy Prattt: Satellite Communications, Wiley India.
3. Pritchard, Suyderhoud and Nelson: Satellite Communication Systems Engineering, Pearson Education. 4. Agarwal: Satellite Communications, Khanna Publishers.
4. Gangliardi: Satellite Communications, CBS Publishers.
5. Chartrand: Satellite Communication, Cengage Learning.
6. Raja Rao: Fundamentals of Satellite communications, PHI Learning
7. NEPTL Lectures.

DE-ECE 501 Electrical Engineering Materials

L-T-P-C
3-0-0-3

Course Objectives: At the end of the course, students will demonstrate the ability to

1. understand bonding in solids, crystal structure structural Imperfections and apply its role in materials behaviour that play a critical role in determining many physical properties.
2. understand electrical and thermal conductivity in metals. Illustrate thermoelectric effect. Evaluate heat developed in current carrying conductors. Also Understand superconductivity and super conducting materials.
3. know basics of magnetic materials and understand soft, hard and permanent magnetic materials.
4. Compare between dielectric and insulator and illustrate effect of dielectric on the behaviour of a capacitor.
5. know about basics of electrical components and understand effect of different electrical materials used in construction of different Electrical Components and classify according to their application.

Syllabus

Unit – 1

Crystal Structure of Materials: A. Bonds in solids, crystal structure, co-ordination number, atomic packing factor, Miller Indices, Bragg's law and x-ray diffraction, structural Imperfections, crystal growth.

B. Energy bands in solids, classification of materials using energy band, direct and indirect band gap materials.

Unit – 2

Conductivity of Metals: Electrical conductivity, factors affecting electrical resistance of materials, thermal conductivity of metals, heat developed in current carrying conductors, thermoelectric effect, superconductors, classification of superconductors, meissner effect, properties and application of superconductors, limitation of superconductors.

.

Unit – 3

Mechanism of Conduction in semiconductor materials: Types of semiconductors, current carriers in semiconductors, Half effect, Drift and Diffusion currents, P-N junction diode, junction transistor, FET & IGFET, properties of semiconducting materials.

Unit – 4

Magnetic Materials: Classification: Diamagnetism, Para magnetism, Ferromagnetism, Anti-ferromagnetism and Ferrimagnetism, magnetostriction, Properties of magnetic materials, soft and hard magnetic materials, permanent magnetic materials, permittivity, dielectric losses and loss tangent, ferro-electricity and piezoelectricity

Unit – 5

Advanced materials: Smart materials, classification and application of smart materials, Introduction to Nano-science and Nano-technology, biomaterials, useful biomaterial in human organs, application of biomaterials.

Text/Reference Books:

1. A.J. Dekker,"Electrical Engineering Materials" Prentice Hall of India
2. R.K. Rajput," Electrical Engg.Materials," Laxmi Publications.
3. C.S. Indulkar & S.Triruvagdan "An Introduction to Electrical Engg. Materials, S.Chand& Co.
4. Solymar, "Electrical Properties of Materials" Oxford University Press.
5. Ian P. Hones," Material Science for Electrical and Electronic Engineering," Oxford University

DE- ECE 502 Electronic Circuit Switching

L-T-P-C
3-0-0-3

Course Outcomes: At the end of the course, students will demonstrate the ability to:

1. Describe and apply fundamentals of telecommunication systems and associated technologies.
2. Solve problems and design simple systems related to tele-traffic and trunking efficiency.
3. Understand and explain the reasons for switching, and the relative merits of the possible switching modes
4. Understand the principles of the internal design and operation of telecommunication switches
5. Understand the Packet Switching & Routing Control Techniques.

Syllabus

Unit-1 (8 Hrs)
Evolution of switching systems: Introduction, Message switching, Circuits switching, Functions of a switching system, Register-transistor-senders, Distribution frames, Crossbar switch, A general trucking, Electronic switching, Reed- electronic system, Digital switching systems.

Unit-2 (8 Hrs)
Digital Switching: Switching functions, Space Division Switching, Time Division Switching, Two-Dimensional Switching, Digital Cross-Connect Systems , Digital Switching in an Analog Environment

Unit-3 (8 Hrs)
Telecom Engineering: Network Traffic Load and Parameters, Grade of Service and Blocking Probability, Modeling Switching Systems, Incoming Traffic and Service Time Characterization, Blocking models and Loss Estimates, Delay Systems

Unit-4 (8 Hrs)
Control of switching systems: Introduction, Call-processing functions, Common control, Reliability, availability and security; Stored-program control. Signalling: Introduction, Customer line signalling, Audio-frequency junctions and trunk circuits, FDM carrier systems, PCM signalling, Inter-register signalling, Common-channel signalling principles, CCITT signalling system no. 6 and 7, Digital customer line signalling.

Unit-5 (8 Hrs)
Packet Switching: Packet Switching, Statistical Multiplexing, Routing Control (dynamic routing, virtual circuit routing and fixed-path routing), Flow Control, X.25, Frame Relay, TCP/IP ATM Cells, ATM Service Categories, ATM Switching (ATM Memory Switch, Space-Memory Switch, Memory-Space Switch, Memory-Space-Memory switch, Banyan Network Switch).

Text/ Reference Books:

1. Thiagarajan Viswanathan & Manav Bhatnagar, Telecommunication Switching Systems & Networks, PHI.
2. J.E. Flood, “Telecommunication Switching, Traffic and Networks”, Pearson Education.
3. John C. Bellamy, “Digital Telephony”, John Wiley, 3rd Ed.

DE- ECE 503 Process Control

L-T-P-C
3-0-0-3

Course Outcomes: At the end of the course, students will demonstrate the ability to:

1. explain the concept of advanced control schemes used in process control.
2. explain the working of distributed control system
3. elaborate the use of artificial intelligence techniques in process control.
4. explain the fundamental concepts of PLC.
5. explain the concept of digital control system.

Syllabus

Unit-1 (8 Hrs)

Introduction to advanced Control Schemes: Cascade, Feed-forward, Feed-forward plus Feedback, Ratio control, Inferential control, Dead time and Inverse response compensation, Adaptive control, Model reference adaptive control, Self tuning regulator Interactions and Decoupling of Control Loops: Design of cross controllers and selection of loops using Relative Gain Array

Unit-2 (8 Hrs)

Distributed Control System (DCS): Evolution and advantages of computer control, Configuration of Supervisory, Direct digital control (DDC) and DCS.

Unit-3 (8 Hrs)

Artificial Intelligence in Process Control: Expert systems, Neural networks, Fuzzy logic, Neuro Fuzzy , Genetic algorithm, Virtual instrumentation.

Unit-4 (8 Hrs)

Programmable Logic Controllers: Comparison with hard wired relay and semiconductor logic, Hardware, Ladder diagram programming, Case studies, Introduction to CPLD, SPLD, FPGA

Unit-5 (8 Hrs)

Digital Control: Sampling and reconstruction, Discrete systems analysis, Stability and controller design using z transform and difference equations, Smoothing filter realization using difference equations

Text / Reference Books:

1. Stephanopoulos, G., Chemical Process Control, Prentice Hall of India Private Limited (1983).
2. Liptak, B.G., Instrument Engineers Handbook , Chilton Book Company (1994).
3. Deb, S.R., Robotics Technology and Flexible Automation, Tata McGraw Hill (1994).
4. Johnson, C.D., Process Control Instrumentation Technology, Prentice Hall of India Private Limited (2007).
5. Zaidi, A., SPC Concepts, Methodologies and Tools, Prentice Hall of India Private Limited (1995).

DE-ECE 504 Embedded Systems

L-T-P-C
3-0-0-3

Course Outcomes: At the end of the course, students will demonstrate the ability to:

1. Understand the basic components of Embedded Systems
2. Identify the hardware and software components of an embedded system
3. Choose appropriate embedded system architecture for the given application
4. Write programs for optimized performance of an embedded system and validate

Syllabus

Unit-1 (9 Hrs)

Introduction: Embedded systems Overview, Characteristics of embedded computing applications. Design Challenges, Common Design Metrics.

Unit-2 (8 Hrs)

Processor Technology, IC Technology, Trade-offs, the development process, Requirements. Specification, Architecture Design, Designing Hardware and Software components. System Integration and Testing, Types of Hardware Platforms, Single board computers.

Unit-3 (8 Hrs)

PC Add-on cards, custom-built hardware platforms, ARM Processor, CPU performance. CPU power consumption, Bus-based computer systems. Memory devices, I/O devices, component interfacing, designing with microprocessors, system level performance analysis. components for embedded programs,

Unit-4 (9 Hrs)

Models of programs, Assembly, Linking, and loading, basic compilation techniques.

Unit-5 (9 Hrs)

Software performance optimization, program level energy and Power analysis, Program validation and Testing.

Text/Reference Books:

1. Wayne Wolf, Computers as Components-Principles of Embedded Computer System Design, Morgun Kaufmann Publisher, 2006.
2. David E-Simon, An Embedded software Primer, Pearson Education, 2007.
3. David Simon, "An Embedded Software Primer",Pearson Education.
4. Himanshu B.Dave, Embedded Systems: Concepts, Design and Programming, Pearson Education. 2015.
5. J.W. Valvano, "Embedded Microcomputer System: Real Time Interfacing", Brooks/Cole, 2000.
6. Jack Ganssle, "The Art of Designing Embedded Systems", Newness, 1999.

DE-ECE 505 Electronic Product Design

L-T-P-C
3-0-0-3

Course Outcomes: At the end of the course, students will demonstrate the ability to:

1. Remember the different considerations of analog, digital and mixed circuit design.
2. Understand various stages of hardware, software and PCB design
3. Acquainted with methods of PCB design and different tools used for PCB Design.
4. Importance of product test & test specifications.
5. Special design considerations and importance of documentation.

Syllabus

Unit-1

Introduction to Electronic Product Design: Man machine dialog and Industrial design, user-centered design, five element of successful design, cognition, ergonomics. Packaging and factors, design for manufacture, assembly and disassembly, wiring, temperature, vibration and shock. Safety, noise, energy coupling, grounding, filtering and shielding.

Unit-2

Hardware Design & testing methods: Design process. Identifying the requirements, formulating specifications, design specifications, Specifications verses requirements, System partitioning, Functional design, architectural design, Functional model verses architectural model. Prototyping. Performance and Efficiency measures. Formulating a test plan, writing specifications, Test procedure and test cases, Egoless design, design reviews. Module debug and test: black box test, white box test, grey box test.

Unit-3

PCB design: Fundamental Definitions, Standards. Routing Topology Configurations, Layer Stack up assignment, Grounding Methodologies, Aspect Ratio, Image Planes, Functional Partitioning, Critical frequencies, Bypassing and decoupling. Design techniques for ESD Protection, Guard Band implementation.

Unit-4

Product Debugging and testing: Steps of Debugging, Techniques for troubleshooting, characterization, Electromechanical components, passive components, active components, active devices, operational amplifier, Analog-Digital Conversion, Digital Components, Inspection and test of components, Simulation, Prototyping and testing, Integration, validation and verification. EMI & EMC issues.

Unit-5

Documentation: Definition, need, and types of documentation. Records, Accountability, and Liability. Audience. Preparation, Presentation, and Preservation of documents. Methods of documentation, Visual techniques, Layout of documentation, Bill of material.

Text/Reference Books:

1. Kim Fowler," Electronic Instrument Design" Oxford university press.
2. Robert J. Herrick, Printed Circuit board design Techniques for EMC Compliance, 2nd edition, IEEE press.
3. Reference Books
4. James K. Peckol, "Embedded Systems – A Contemporary Design Tool", Wiley publication
5. J C Whitakar," The Electronics Handbook", CRC press

DE-ECE 601 Power Electronics

L-T-P-C
4-0-0-4

Course Outcomes: At the end of the course, students will demonstrate the ability to:

1. analyze different types of power semiconductor devices and their switching.
2. demostrate the triggering circuit and snubber circuit and Classify the operation of choppers and basic topologies of DC-DC Switching regulators.
3. illustrate the operation of AC voltage controller and cyclo- converter and its application.
4. analyze operation, characteristics and performance parameter of controlled rectifiers.
5. analyze the operation of single phase and three phase inverters with and without PWM techniques and to understand harmonic reduction methods.

Syllabus

Unit-1 (8 Hrs)

Power Semiconductor Devices: Diode, Thyristors, BJT, Power MOSFET and Power IGBT and their characteristics. Firing Circuit for Thyristor. Two transistor analogy of SCR, Series and parallel connections of SCR's. Thyristor Commutation Technique. Gate drive Circuits for MOSFET and IGBT. GTO, MCT and TRIAC .

Unit-2 (8 Hrs)

Single phase half wave controlled, rectifier with resistive and inductive loads, effect of freewheeling diode. Single phase fully controlled and half controlled bridge converters. Three phase half wave converters, Three phase fully controlled and half controlled bridge converters, Effect of source impedance, Single phase and three phase dual converters. Resonant converters

Unit-3 (7 Hrs)

Choppers: Time ratio control and Current limit control strategies Step down choppers-Derivation of load voltage and currents with R, RL and RLE loads-Step up Chopper load voltage expression. Morgan's chopper Jones chopper Oscillation choppers (Principle of operation only) -waveforms AC Chopper Problems.

Unit-4 (6 Hrs)

Principle of On-Off and phase controls, Single phase ac voltage controller with resistive and inductive loads. Three phase ac voltage controllers (various configurations and comparison), Single phase transformer tap changer.

Cyclo -Converters, Basic principle of operation, single phase to single phase, three phase to single phase and three phase to three phase cyclo-converters, output voltage equation

Unit-5 (8 Hrs)

Single-phase voltage source inverter: Power circuit of single-phase voltage source inverter, switch states and instantaneous output voltage, square wave operation of the inverter, concept of average voltage over a switching cycle, bipolar sinusoidal modulation and unipolar sinusoidal modulation, modulation index and output voltage

Three-phase voltage source inverter: Power circuit of a three-phase voltage source inverter, switch states, instantaneous output voltages, average output voltages over a sub-cycle, three-phase sinusoidal modulation. Harmonics reduction techniques, Single phase and three phase current source inverters.

Text/ Reference Books:

1. P.S.Bhimbra, “Power Electronics“,Khanna publications.

2. M.D.Singh&K.B.Kanchandhani, Power Electronics, Tata McGrawHill Publishing company, 1998.
1. VedamSubramanyam, Power Electronicsby New Age International (P) Limited, Publishers
2. P.C.Sen, Power Electronics, Tata McGraw-Hill Publishing.

DE-ECE 602 High Speed Semiconductor devices

L-T-P-C
4-0-0-4

Course Outcomes: At the end of the course, students will demonstrate the ability to:

1. Knowledge of materials (compound semiconductor) used in high speed devices and their properties and the advanced technologies for high speed electron devices
2. Knowledge of high speed electron devices operation along with their descriptive models and the operation of selected optoelectronic devices
3. Exploit small-signal equivalent circuit models of high frequency electron devices (MESFETs, HEMTs, HBTs)
4. Knowledge of material and device processing techniques of High speed semiconductor devices

Syllabus

Unit-1 (8 Hrs)

Introduction: Important parameters governing the high speed performance of devices and circuits: Transit time of charge carriers, junction capacitances, ON-resistances and their dependence on the device geometry and size, carrier mobility, doping concentration and temperature; important parameters governing the high power performance of devices and circuits: Break down voltage, resistances, device geometries, doping concentration and temperature

Unit-2 (7 Hrs)

Materials properties: Merits of III –V binary and ternary compound semiconductors (GaAs, InP, InGaAs, AlGaAs, SiC, GaN etc.), different SiC structures, silicon-germanium alloys and silicon carbide for high speed devices, as compared to silicon based devices, outline of the crystal structure, dopants and electrical properties such as carrier mobility, velocity versus electric field characteristics of these materials, electric field characteristics of materials and device processing techniques, Band diagrams, homo and hetro junctions, electrostatic calculations, Band gap engineering, doping, Material and device process technique with these III-V and IV – IV semiconductors.

Unit-3 (8 Hrs)

Metal semiconductor contacts and Metal Insulator Semiconductor and MOS devices: Native oxides of Compound semiconductors for MOS devices and the interface state density related issues. Metal semiconductor contacts, Schottky barrier diode, Metal semiconductor Field Effect Transistors (MESFETs): Pinch off voltage and threshold voltage of MESFETs. D.C. characteristics and analysis of drain current. Velocity overshoot effects and the related advantages of GaAs, InP and GaN based devices for high speed operation. Sub threshold characteristics, short channel effects and the performance of scaled down devices.

Unit-4 (8 Hrs)

High Electron Mobility Transistors (HEMT): Hetero-junction devices. The generic Modulation Doped FET (MODFET) structure for high electron mobility realization. Principle of operation and the unique features of HEMT, InGaAs/InP HEMT structures: Hetero junction Bipolar transistors (HBTs): Principle of operation and the benefits of hetero junction BJT for high speed applications. GaAs and InP based HBT device structure and the surface passivation for stable high gain high frequency performance. SiGe HBTs and the concept of strained layer devices; High Frequency resonant – tunneling devices, Resonant-tunneling hot electron transistors.

Text/Reference Books:

1. C.Y. Chang, F. Kai, GaAs High-Speed Devices: Physics, Technology and Circuit Applications Wiley

2. Cheng T. Wang, Ed., Introduction to Semiconductor Technology: GaAs and Related Compounds, John Wiley & Sons
3. David K. Ferry, Ed., Gallium Arsenide Technology, Howard W. Sams& Co., 1985
4. Avishay Katz, Indium Phosphide and Related materials: Processing, Technology and Devices, Artech House, 1992.
5. S.M. Sze, High Speed Semiconductor Devices, Wiley (1990) ISBN 0-471-62307-5
6. Ralph E. Williams, Modern GaAs Processing Methods, Artech (1990), ISBN 0-89006-343-5
7. SandipTiwari, Compound Semiconductor Device Physics, Academic Press (1991), ISBN 0-12-691740-X
8. G.A. Armstrong, C.K. Maiti, TCAD for Si, SiGe and GaAs Integrated Circuits, The Institution of Engineering and Technology, London, United Kingdom, 2007, ISBN 978-0-86341-743-6.
9. Ruediger Quay, Gallium Nitride Electronics, Springer 2008, ISBN 978-3-540-71890-1, (Available on NITC intranet in Springer eBook section)
10. Prof. Dr. Alessandro Birolini, Reliability Engineering Theory and PracticeSpringer 2007, ISBN-10 3-540- 40287-X, Available on NITC intranet in Springer eBook section)

DE-ECE 603 Optical Networks

L-T-P-C
4-0-0-4

Course Outcomes: At the end of the course, students will demonstrate the ability to:

1. Familiarize with basic concepts and theory of Optical Communication
2. Demonstrate optical components, assemble them and solve problems on Optical Communication system
3. Able to design, implements, analyse and maintains optical communication system
4. Gain knowledge of different source of light as well as receiver and their comparative study
5. To get idea about power budget and ultimately be an engineer with adequate knowledge in optical domain

Syllabus

Unit-1 (8 Hrs)

Introduction to Optical Network: Telecommunication networks, First generation optical networks, Multiplexing techniques, Second generation optical networks, System and network evolution, optical layer, optical packet switching. Block diagram of optical fiber communication system, advantage of optical fiber communication, basic structure of optical fiber, light propagation in optical fiber using ray theory transmission, Total internal reflection, acceptance angle, numerical aperture.

Unit-2 (8 Hrs)

Optical Couplers, Isolators, Circulators, Multiplexers and filters, large optical switches, Crosstalk: Intra-channel crosstalk, inter-channel crosstalk, crosstalk in Networks, Absorption losses, scattering losses, bending losses, distortion in optical fiber communication system, optical power launching, coupling, power calculation, fiber to fiber joints, fiber splicing technique, fiber connectors.

Unit-3 (8 Hrs)

Transmitters, detectors, Switches, SONET/SDH Multiplexing, SONET/SDH layers, SONET Frame structure, SONET/SDH physical layer, Elements of a SONET/SDH infrastructure, Quality of service, WDM Network elements, LASER, LED: structures, characteristics, advantages, applications.

Unit-4 (8 Hrs)

WDM Network, Cost Trade-offs, Light path Topology, Routing and wavelength assignment problems, Network Survivability, Protection in SONET/SDH, Optical Layer Protection, Different Schemes, Interworking between Layers, Photodiodes, Phototransistors, Optical Power meter

Unit-5 (8 Hrs)

Optical Switching, Point to point link, system considerations, link power budget, rise time budget, modulation formats for optical communication system, introduction to WDM concepts, multiplexing strategies in optical network.

Text / Reference Books:

1. R. Ramaswami, & K. N. Sivarajan, Optical Networks a Practical perspective, Morgan Kaufmann Publishers.
2. U. Black, "Optical Networks: Third Generation Transport Systems"/ Pearson Educations.
3. G. Keiser: Optical Fiber Communication – MGH
4. J.M. Senior : Optical Fiber Communication – PHI

DE-ECE 604 Consumer Electronics

L-T-P-C
4-0-0-4

Course Outcomes: Student will be able to

1. Identify and explain basic working of electronics products like TV, Microphone, loudspeaker, AC, Microwave ovens.
2. learn various components of composite video signal and differentiate between line, brightness, saturation and to design the lower power consumption device, the primary challenge is how to minimize overall cost.
3. acquire ability to design different display screen so as effect of radiations on eyes will be reduced.
4. Understand the general importance of product safety to consumers & producers will reduce the various adverse impacts of these devices on common man.

Syllabus

Unit-1 (9 Hrs)

Monochrome TV (Introduction): Elements of a TV System, Picture transmission, Sound transmission, Picture reception, Sound reception, Synchronization, Receiver control, Image continuity, Scanning Process, Aspect Ratio, Flicker, Composite Video Signal, Picture Elements, Kell factor, Vertical Resolution, Horizontal Resolution, Video bandwidth, Interlacing, 625 Line System, Bandwidths for TV Transmission, Vertical and horizontal synch detail, Vestigial Side Band transmission (Advantages and Disadvantages)

Unit-2 (7 Hrs)

Monochrome TV (Picture and Camera Tubes): Monochrome picture tube, beam reflection, Beam focusing, Screen Phosphor, Face plate, Picture tube characteristics, picture tube circuit controls, Monochrome Camera Tubes: Basic principle, Image Orthicon, Vidicon, Plumbicon

Unit-3 (8 Hrs)

Colour TV Essentials: Compatibility , Colour perception,Three Colour theory, Luminance, Hue and Saturation, Dispersion and Recombination of light, Primary and secondary colours, luminance signal, Chrominance Signal, Colour picture tube,colour TV Camera, Colour TV display Tubes, colour Signal Transmission, Bandwidth for colour signal transmission, Colour TV controls. Cable TV, Block Diagram and principle of working of cable TV.

Plasma and LCD:

Introduction,liquid crystals,types of LCD's,TN,STN,TFT,Power requirements,LCD working,Principle of operation of TN display,Construction of TN display,Behaviour of TN liquid crystals,Viewing angle,colour balance, colour TN display, limitatons, advantages, disadvantages, applications.

Unit-4 (9 Hrs)

LED and DMD: Introduction to LED Television , comparison with LCD and Plasma TV's, schematic of DMD, introduction to Digital MicroMirror device, Diagram of DMD, principle of working, emerging applications of DMD.

Microwave Ovens and Air Conditioners: Microwaves, Transit Time, Magnetron, Waveguides, Microwave Oven, Microwave Cooking. Air conditioning, Components of air conditioning systems, all water Air conditioning systems, air conditioning Systems, Split air conditioner.

Unit-5 (10 Hrs)

Microphones: Introduction, characteristics of microphones, types of microphone: carbon, moving coil, wireless, crystal, introduction to tape recorder.

Loudspeaker: Introduction to ideal and basic loudspeaker, loudspeaker construction types of loudspeaker: Dynamic and permanent magnet, woofers, tweeters, brief introduction to baffles, equalisers.

Text/Reference Books:

1. Consumer Electronics by S. P. Bali Pearson Education.
2. Complete Satellite and Cable T.V by R.R Gulati(New Age International Publishers)
3. Monochrome and Colour Television by R. R. Gulati

DE-ECE 605 Computer Networks

L-T-P-C
4-0-0-4

Course Outcomes: At the end of the course, students will demonstrate the ability to:

1. Study the basic taxonomy and terminology of the computer networking and enumerate the layers of OSI model and TCP/IP model. To understand the fundamentals and basics of Physical layer, and to apply them in real time applications.
2. Study and evaluate medium access layer protocols. To learn data link layer concepts, design issues, and protocols and demonstrate knowledge of various error detection, correction and flow control techniques in data link layer.
3. Classify the routing protocols, analyze how to assign the IP addresses for the given network and to evaluate different congestion control methods.
4. Understand, analyze and evaluate a number of Transport layer and presentation layer services, and protocols.
5. Understand the functions of Application layer paradigms and Protocols.

Syllabus

Unit-1

Introduction Concepts: Goals and Applications of Networks, Network structure and architecture, TCP/IP MODEL, The OSI reference model, services, Network Topology Design - Delay Analysis, Back Bone Design, Local Access Network Design.

Physical Level: Overview of data(analog & digital), signal(analog & digital), transmission (analog & digital) & transmission media (guided & unguided); Circuit switching: time division & space division switch

Unit-2

Medium Access sub layer: Medium Access sub layer – Channel Allocations, LAN protocols , Multiple access protocols: Pure ALOHA, Slotted ALOHA, CSMA, CSMA/CD, CSMA/CA.

Data Link Layer - Types of errors, framing(character and bit stuffing), error detection & correction methods; Flow control; Protocols: Stop & wait ARQ, Go-Back- N ARQ, Selective repeat ARQ.

Unit-3

Network Layer: Network Layer - Point - to Pont Networks, routing, Congestion control, Internetworking -TCP / IP - IP packet, IP address, IPv6. '

Unit-4

Transport Layer: Transport Layer - Design issues, connection management, session Layer Design issues, remote procedure call. Presentation Layer-Design issues, Data compression techniques, cryptography - TCP – Window Management.

Unit-5

Application Layer: Application Layer: File Transfer, Access and Management, Electronic mail, Virtual Terminals, Other application, Example Networks - Internet and Public Networks.

Text / Reference Books:

1. Forouzan, Data Communication & Networking, McGrawhill Education
2. Lathi, B. P. & Ding, Z., 2010, Modern Digital and Analog Communication Systems, Oxford University Press.
3. Stallings, W., (2010), Data and Computer Communications, Pearson.
4. Andrew S. Tanenbaum, “Computer Networks” Pearson.
5. Ajit Pal, “Data Communication and Computer Networks”, PHI
6. Dimitri Bertsekas, Robert G. Gallager, “Data Networks”, Prentice Hall, 1992

DE-ECE 701 VLSI

L-T-P-C
3-0-0-3

Course Outcomes: After the successful completion of the course the students will be able to:

1. Students are able to know how to place the blocks and how to partition the blocks while for designing the layout for IC.
2. Students are able to solve the performance issues in circuit layout.
3. Students are able to analyze CMOS & NMOS process technology.
4. Students are able to understand theSequential MOS logic circuit.
5. Students are able to analyze circuits using both analytical and CAD tools.

Syllabus

Unit-1 (10 Hrs)

VLSI design Introduction: Evolution of VLSI, VLSI designing methodology, design flow, design Hierarchy, VLSI design style, Design quality, computer aided design technology.

Introduction to MOS: MOS transistor theory, MOS structure, enhancement & depletion transistor, threshold voltage, MOS device design equations, MOSFET scaling and small geometry effects, MOSFET capacitances.

Unit-2 (8 Hrs)

NMOS inverter, CMOS inverter, DC characteristics, static load MOS inverter, pull up/pull down ratio, static & dynamic power dissipation, CMOS logic gate design: NAND, NOR, XOR and XNOR gates, Transistor sizing, combinational MOS logic circuits: pass transistor and transmission gate designs, Pseudo NMOS logic.

Unit-3 (7 Hrs)

CMOS & NMOS process technology: explanation of different stages in fabrication, body effect, latch up in CMOS.

Stick diagram and design rules, lambda-based design rules, switching characteristics & inter connection effects: rise time, fall time delays, noise margin.

Unit-4 (8 Hrs)

Sequential MOS logic circuits: SR latch, clocked latch and flip flop circuits, CMOS D latch and edge triggered flip flop, dynamic logic circuits; basic principle, non-ideal effects, domino CMOS logic, high performance dynamic CMOS circuits.

Unit-5 (8 Hrs)

Physical Design: Introduction to ECAD tools for first and back end design of VLSI circuits. Custom/ASIC design, Design using FPGA and VHDL. VHDL Code for simple Logic gates, flip-flops, shift registers

Text/Reference books:

1. S. M. Kang, Y. Lebiebici, CMOS digital integrated circuits analysis & design, Tata McGraw Hill.
2. Pucknell Douglas A., Eshraghian Kamran, Basic VLSI Design - PHI Learning Pvt Limited.
3. N.Weste and K. Eshraghian, Principles of CMOS VLSI, 2e, Pearson Education. 2011
4. VLSI Design , P PSahu , , McGraw. 2013
5. VLSI Design, D.P. Das, Oxford. 2011
6. Chip Design for Submicron VLSI: CMOS Layout & Simulation, Uyemura, cengage learning

DE- ECE 702 Nano-Electronics

L-T-P-C
3-0-0-3

Course Outcomes: At the end of this course, student will have the ability to:

1. Use the fundamental science and engineering principles relevant to materials that include the relationships between characterization, properties, performance and design of materials results in better applications.
2. Possess the skills and techniques necessary for handling dielectric materials.
3. Become leaders in IC fabrication and possibly become entrepreneur which will contribute in society upliftment.
4. Use lifelong learning skills to develop knowledge and skills to take advantage of nanomaterials in professional development opportunities in term reduce the size, cost and power requirement of existing devices and technology.

Syllabus

Unit-1 (10 Hrs)
Introduction to Electronic Materials: Thermodynamics of Materials; Mechanical Properties of Materials; Bonding, Structure and Crystallography; Advanced Fluid-Solid Reaction Engineering; Microstructural and Microchemical Characterization of Materials.
Material Basics: Ohms Law and Materials Properties; The Hall Effect; Conductors – Metals, Alloys, Non-metallic Conductors; Contacts, Resistors and Heating; Thermionic Emission, Tunneling, Thermoelectric Effects; Ionic conductors: Debye Length, Nernst Equation.

Unit-2 (11 Hrs)
Introduction to Dielectrics: Dielectrics – Mechanisms of Polarization; Frequency dependence of Dielectric constants; Dielectric Losses; Mechanisms of Electrical Breakdown; Piezo-electricity; Ferro-electricity; Dielectrics and Optics.
Basics of Magnetics: Magnetics – Origin of Magnetic dipoles; Types of Magnetisms: Diamagnetism, Para-magnetism and Ferro-magnetism; Magnetic data storage.

Unit-3 (13 Hrs)
Advanced Materials: MEMS; NEMS; CNTS; Novel semiconductors; Photovoltaic materials.
Materials for IC Fabrication: Materials and Processes for Silicon Technology; Si Oxide, LOCOS Process; Chemical Vapor Deposition: Silicon Epitaxy, Oxide CVD, CVD for Poly-Silicon, Silicon Nitride and Miscellaneous Materials; Etching Techniques: Chemical Etching, Plasma Etching; Lithography: Basic Lithography Techniques, Resist and Steppers; Electrochemistry of Silicon.

Unit-4 (8 Hrs)
Electronic Devices: Electronic Device Components: Wires & Cables, Semiconductors, Capacitors, PCBs, MEMS, Battery, CD-R, EMI/RFI, ITO, Electro-wetting, LCD &LED; CDs and DVDs.

Unit-5 (6 Hrs)
Nanotechnology in Electronics: Nanotechnology in Electronics: Magnetoresistive Random Access Memory (MRAM); Self-assembled nanostructures; Nano-photonics; Nano-ionics; Molecular electronics; Nanomaterials electronics; Nanofabrication.

Text/Reference Books:

1. Heath Michael T., "Scientific Computing: An Introductory Survey", McGraw-Hill,2nd Ed., 2002
2. Press William H., Saul A. Teukolsky, Vetterling William T and Brian P. Flannery,"Numerical Recipes: The Art of Scientific Computing", Cambridge University Press,3rd Ed., 2007

3. Xin-she Yang (Ed.). Introduction to Computational Mathematics, World Scientific Publishing Co., 2nd Ed.
4. George W. Hanson, Fundamentals of Nanoelectronics, Pearson Education.
5. Kiryanov D. and Kiryanova E., "Computational Science", Infinity Science Press, 1stEd., 2006
6. 2.Quarteroni, Alfio, Saleri, Fausto, Gervasio and Paola, "Scientific Computing With MATLAB and Octave", Springer, 3rd Ed., 2010

DE-ECE 703 Information Theory & Coding

L-T-P-C
3-0-0-3

Course Outcomes: At the end of the course, students will demonstrate the ability to:

1. Model the Entropy, Joint Entropy and Conditional Entropy, Relative Entropy and Mutual Information, Relationship Between Entropy and Mutual Information
2. Design Data Compression, Examples of Codes, Kraft Inequality, Optimal Codes, Bounds on the Optimal Code Length
3. Identify the Examples of Channel Capacity, Symmetric Channels, Properties of Channel Capacity, Preview of the Channel Coding Theorem.
4. Analyse Introduction to block codes, Single-parity-check codes, Product codes, Repetition codes, Hamming codes
5. Design Generator matrices for convolutional codes, Generator polynomials for convolutional codes

Syllabus

Unit-1 (8 Hrs)

Entropy: Entropy, Joint Entropy and Conditional Entropy, Relative Entropy and Mutual Information, Relationship Between Entropy and Mutual Information, Chain Rules for Entropy, Relative Entropy, and Mutual Information, Jensen's Inequality and Its Consequences, Log Sum Inequality and Its Applications, Data-Processing Inequality, Sufficient Statistics, Fano's Inequality

Unit-2 (8 Hrs)

Asymptotic Equipartition Property: Asymptotic Equipartition Property Theorem, Consequences of the AEP: Data Compression, High-Probability Sets and the Typical Set Data Compression: Examples of Codes, Kraft Inequality, Optimal Codes, Bounds on the Optimal Code Length, Kraft Inequality for Uniquely Decodable Codes, Huffman Codes, Some Comments on Huffman Codes, Optimality of Huffman Codes, Shannon–Fano–Elias Coding

Unit-3 (8 Hrs)

Channel Capacity: Examples of Channel Capacity, Symmetric Channels, Properties of Channel Capacity, Preview of the Channel Coding Theorem, Definitions, Jointly Typical Sequences, Channel Coding Theorem

Unit-4 (8 Hrs)

Block Codes: Digital communication channel, Introduction to block codes, Single-parity check codes, Product codes, Repetition codes, Hamming codes, Minimum distance of block codes, Soft-decision decoding, Automatic-repeat-request schemes, Linear codes, Definition of linear codes, Generator matrices, Standard array, Parity-check matrices, Error.

Unit-5 (8 Hrs)

Convolution codes: Encoding convolutional codes, Generator matrices for convolutional codes, Generator polynomials for convolutional codes, Graphical representation of convolutional codes, Viterbi decoder

Text / Reference Books:

1. Bose, Inforrmation Theory, Coding and Cryptography, Mcgrawhill Education
2. Joy A. Thomas, Thomas M. Cover, Elements of information theory, Wiley-Interscience; 2edition (2006)
3. S. Gravano, "Introduction to Error Control Codes" OUP Oxford (24 May 2001)
4. Robert B. Ash, "Information Theory", Dover Publications (November 1, 1990)
5. Todd k Moon, "Error Correction Coding: Mathematical Methods and Algorithms " Wiley,2005

DE-ECE 704 Artificial Intelligence

L-T-P-C
3-0-0-3

Course Outcomes: At the end of the course, students will demonstrate the ability to:

1. Demonstrate knowledge of the building blocks of AI as presented in terms of intelligent agents. Apply concept of Natural Language processing to problems leading to understanding of cognitive computing.
2. Analyze and formalize the problem as a state space, graph, design heuristics and select amongst different search or game based techniques to solve them.
3. Develop intelligent algorithms for constraint satisfaction problems and also design intelligent systems for Game Playing.
4. To study and apply the basic issues of knowledge representation and Logic and blind and heuristic search, as well as an understanding of other topics such as chaining, resolution, etc. that play an important role in AI programs.
5. To understand various machine learning techniques and models.

Syllabus

Unit-1 (10 Hrs)

Introduction: Introduction to Artificial Intelligence, Foundations and History of Artificial Intelligence, Applications of AI, Natural Language Processing, Robotics and Computer Vision, Intelligent Agents, Structure of Intelligent Agents.

Unit-2 (8 Hrs)

Searching for solutions State-Space Search, Problem Solving , Generate and Test, Means-Ends Analysis, search in AND/OR graphs Uniformed search strategies: Breadth First Search, Depth First Search and Depth limited Search, Iterative Deepening Search, Informed search strategies: Heuristic function: Best First Search, A* search, AO* search, Bidirectional Search, The Branch and Bound Algorithm

Unit-3 (7 Hrs)

Local search algorithms and optimistic problems: Hill Climbing, Local Beam Search, Simulated Annealing, Genetic Algorithms, Constraint Satisfaction Problem, Constraint Optimization Adversial Search, Game Playing − Optimal decisions in games − Minimax algorithm, Alpha Beta Pruning

Unit-4 (7 Hrs)

Knowledge Representation & Reasoning: Propositional logic, Theory of first order logic, Inference in First order logic, Forward & Backward chaining, Resolution, Probabilistic reasoning, Utility theory, Hidden Markov Models (HMM), Bayesian Networks.

Unit-5 (8 Hrs)

Machine Learning: Supervised and unsupervised learning, Decision trees, Statistical learning models, learning with complete data - Naive Bayes models, Learning with hidden data - EM algorithm, Reinforcement learning.

Text/Reference Books:

1. Stuart Russell, Peter Norvig, "Artificial Intelligence – A Modern Approach", Pearson Education
2. Elaine Rich and Kevin Knight, "Artificial Intelligence", McGraw-Hill
3. E Charniak and D McDermott, "Introduction to Artificial Intelligence", Pearson Education
4. Dan W. Patterson, "Artificial Intelligence and Expert Systems", Prentice Hall of India,

DE-ECE 705 Electromagnetic Interference

L-T-P-C
3-0-0-3

Course Outcomes: At the end of the course, students will demonstrate the ability to:

1. Understand the basics of Electromagnetic Interference and Engineering Applications
2. Describe different coupling methods and transient sources
3. Analyze different mitigation techniques for electromagnetic interference control
4. Discuss different standards and regulations for EMI control
5. Descibe different testing methods and instruments for the measurement of electromagnetic interference

Syllabus

Unit-1 (7 Hrs)

Basic Theory : Introduction to EMI and EMC, Intra and inter system EMI, Elements of Interference, Sources and Victims of EMI, Conducted and Radiated EMI emission and susceptibility, Case Histories, Radiation hazards to humans, Various issues of EMC, EMC Testing categories, EMC Engineering Application.

Unit-2 (7 Hrs)

Coupling Mechanism: Electromagnetic field sources and Coupling paths, Coupling via the supply network, Common mode coupling, Differential mode coupling, Impedance coupling, Inductive and Capacitive coupling, Radiative coupling, Ground loop coupling, Cable related emissions and coupling, Transient sources, Automotive transients.

Unit-3 (8 Hrs)

EMI Mitigation Techniques: Working principle of Shielding and Murphy‟s Law, LF Magnetic shielding, Apertures and shielding effectiveness, Choice of Materials for H, E, and free space fields, Gasketting and sealing, PCB Level shielding, Principle of Grounding, Isolated grounds, Grounding strategies for Large systems, Grounding for mixed signal systems, Filter types and operation, Surge protection devices, Transient protection.

Unit-4 (6 Hrs)

Standards And Regulation: Need for Standards, Generic/General Standards for Residential and Industrial environment, Basic Standards, Product Standards, National and International EMI Standardizing Organizations; IEC, ANSI, FCC, AS/NZS, CISPR, BSI, CENELEC, ACEC. Electro Magnetic Emission and susceptibility standards and specifications, MIL461E Standards.

Unit-5 (8 Hrs)

EMI Test Methods And Instrumentation: Fundamental considerations, EMI Shielding effectiveness tests, Open field test, TEM cell for immunity test, Shielded chamber , Shielded anechoic chamber, EMI test receivers, Spectrum analyzer, EMI test wave simulators, EMI coupling networks, Line impedance stabilization networks, Feed through capacitors, Antennas, Current probes, MIL -STD test methods, Civilian STD test methods.

Text/ Reference Books:

1. V Prasad Kodali, “Engineering Electromagnetic Compatibility”, IEEE Press, Newyork, 2001.
2. Henry W. Ott, “Electromagnetic Compatibility Engineering”, John Wiley & Sons Inc, Newyork, 2009
3. Daryl Gerke and William Kimmel, “EDN‟s Designer‟s Guide to Electromagnetic Compatibility”, Elsevier Science & Technology Books, 2002

DE-ECE 801 Microwave and Radar Engineering

L-T-P-C
4-0-0-4

Course Outcomes: After the successful completion of the course the students will be able to:

1. Understand various wave propagation modes of propagation
2. Design impedance matching network for any transmission line or system.
3. Analyze and find applications and limitations of microwave tube Generators and Amplifiers.
4. Understand equation, block diagram &Applications of radar.
5. Understand the different types of Radar systems with their applications.

Syllabus

Unit-1 (10 Hrs)

Introduction: Wave Propagation Modes of Propagation, Plane Earth Reflection, Surface Wave, Field strength, Elevated Dipole Antennas above a Plane Earth, Wave tilt of the Surface Wave, Spherical Earth Propagation, Tropospheric Wave. Ionosphere Propagation, Sky Wave Transmission Calculations, Effect of the Earth's Magnetic Field, Virtual Height, MUF/LUF, Skip distance, Ionospheric Variations and Fading. Space Waves: Radio Horizon, Microwave space wave Propagation, Duct Propagation.

Unit-2 (8 Hrs)

Wave Guides: Guided waves between parallel plates, Dielectric slab Waveguide, Rectangular, Circular waveguides, Transmission Line Analogy for waveguides ,Microwave Components Waveguide couplings, bends and twists, tees, transitions, matched load, Attenuators and phase shifters, wave guide discontinuities, windows Irises and tuning screws, Two-hole directional coupler, Isolators and circulators.

Unit-3 (7 Hrs)

Microwave Generation: Limitations of Conventional Vacuum Tubes, Klystron(Reflex and Multi-cavity), TWT, Magnetrons, and BWO, Negative conductance Microwave devices: Tunnel diode, Gunn diode, IMPATT diode.

Unit-4 (8 Hrs)

Introduction to Radar: Basic radar, The simple form of radar equation, Radar block diagram, Radar frequencies, Applications to radar

Unit-5 (8 Hrs)

Radar Equation: Introduction, Detection of signal in noise, Receiver **noise** and the signal to noise ratio, Probability density functions, Probabilities of detection and false alarm, Integration of Radar pluses, Radar cross section of targets, Radar cross section fluctuations, Transmitter power, Pulse repetition frequency, antenna parameters, system losses, Other Radar equation considerations.

Text/References Books:

1. Jordan and Balmian,'Electromagnetic waves and radiating sytems',PHI.
2. Liao,Y, "Microwave Devices and Cricuits", Prentice Hall of India.
3. S.Kulkarni," Microwave Engineering" ,Umesh Publication,2009.
4. Merrill I. Skolnik" Introduction to Radar Systems" Third Edition.
5. Reich, "Microwave principles", CBS, 1996.
6. Collin, "Foundation of Microwave Engineering", 2nd cd. McGraw Hill, 1992.
7. Watson, "Microwave Semiconductor Devices and Their Circuit Applications", McGraw Hill.
8. J.C. Toomay , Paul J. Hannen " Principles of Radar" Third Edition.

9. GottapuSasibhusanaRao, “Microwave and Radar Engineering, Pearson.

DE-ECE 802 Digital Image Processing

L-T-P-C
4-0-0-4

Course Outcomes: After the successful completion of the course the students will be able to:

1. Review the fundamental concepts of a digital image processing system.
2. Analyze images in the frequency domain using various transforms.
3. Evaluate the techniques for image enhancement and image restoration.
4. Categorize various compression techniques.
5. Interpret Image compression standards.
6. Interpret image segmentation and representation techniques.

Syllabus

Unit-1 (8 Hrs)

Introduction and Fundamentals: Motivation and Perspective, Applications, Components of Image Processing System, Element of Visual Perception, A Simple Image Model, Sampling and Quantization.

Unit-2 (9 Hrs)

Image Enhancement: Spatial Domain: Gray level transformations – Histogram processing – Basics of Spatial Filtering– Smoothing and Sharpening Spatial Filtering, Frequency Domain: Introduction to Fourier **Transform:** Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters, Homomorphic filtering, Color image enhancement Sharpening – The Laplacian

Unit-3 (9 Hrs)

Image Restoration, Image Enhancement in Spatial Domain: Introduction; Basic Gray Level Functions– Piecewise-Linear Transformation Functions: Contrast Stretching; Histogram Specification; Histogram Equalization; Local Enhancement; Enhancement using Arithmetic/Logic Operations – Image Subtraction,Image Averaging; Basics of Spatial Filtering; A Model of Restoration Process, Noise Models, Restoration in the presence of Noise only-Spatial Filtering – Mean Filters: Arithmetic Mean filter, Geometric Mean Filter, Order Statistic Filters – Median Filter, Max and Min filters; Periodic Noise Reduction by Frequency Domain Filtering – Bandpass Filters; Minimum Mean-square Error Restoration.

Unit-4 (8 Hrs)

Morphological Image Processing: Introduction, Logic Operations involving Binary Images, Dilation and Erosion, Opening and Closing,
Morphological Algorithms – Boundary Extraction, Region Filling, Extraction of Connected Components, Convex Hull, Thinning, Thickening

Unit-5 (8 Hrs)

Registration: Introduction, Geometric Transformation – Plane to Plane transformation, Mapping, Stereo Imaging – Algorithms to Establish Correspondence, Algorithms to Recover Depth Segmentation Introduction, Region Extraction, Pixel-Based Approach, Multi-level Thresholding, Local Thresholding, Region-based Approach, Edge and Line Detection: Edge Detection, Edge Operators, Pattern Fitting Approach, Edge Linking and Edge Following, Edge Elements Extraction by Thresholding, Edge Detector Performance, Line Detection, Corner Detection.

Text/ Reference Books:

1. Rafael C. Gonzalvez and Richard E. Woods, Digital Image Processing 2nd Edition,.Pearson Education.
2. R.J. Schalkoff, Digital Image Processing and Computer Vision,.: John Wiley and Sons, NY.
3. A.K. Jain, Fundamentals of Digital Image Processing,. Prentice Hall, Upper Saddle River, NJ.
4. Sonka, Digital Image Processing and Computer Vision, Cengage Learning
5. Gonzalez and Woods, Digital Image Processing, Addison Wesley.

DE-ECE 803 Opto Electronic Devices

L-T-P-C
4-0-0-4

Course Outcomes: After the successful completion of the course the students will be able to:

1. Understand optical processes such as recombination and absorption in semiconductors.
2. Understand different LED structures with material properties.
3. Explain the principle and working of optical modulators.
4. Analyze different types of photo detectors.
5. Understand the principle and working of optical components.

Syllabus

Unit-1 (7 Hrs)

Optical processes in semiconductors, electron hole recombination, absorption, Franz-Keldysh effect, Stark effect, quantum confined Stark effect, deep level transitions, Auger recombination heat generation and dissipation, heat sources.

Unit-2 (8 Hrs)

Nitride light emitters, nitride material properties, InGaN/GaN LED, structure and working, performance parameters, InGaN/GaN Laser Diode, structure and working, performance parameters. White-light LEDs, generation of white light with LEDs, generation of white light by dichromatic sources, generation of white light by trichromatic sources, temperature dependence of trichromatic, 7generation of white light bytetrachromatic and penta chromatic sources, white-light sources based on wavelength converters

Unit-3 (7 Hrs)

Optical modulators using pn junction, electro-optical modulators, acousto- optical modulators, Raman-Nath modulators, Franz-Keldysh and Stark effect modulators, quantum well electro-absorption modulators, optical switching and logic devices, optical memory.

Unit-4 (9 Hrs)

Optical detection –PIN, APD, modulated barrier photodiode, Schottky barrier photodiode, wavelength selective detection, micro cavity photodiodes. Optoelectronic ICs, advantages, integrated transmitters and receivers, guided wave devices. Working of LDR, liquid crystal display, structure, TFT display, structure, polymer LED, organic LED.

Unit-5 (8 Hrs)

Introduction to optical components, directional couplers, multiplexers, attenuators, isolators, circulators, tunable filters, fixed filters, add drop multiplexers, optical cross connects, wavelength convertors, optical bistable devices.

Text/Reference Books:

1. Pallab Bhattacharya: Semiconductor Optoelectronic Devices, Pearson, 2009
2. Yariv, Photonics Optical Electronics in modern communication, 6/e ,Oxford Univ
3. Alastair Buckley, Organic Light-Emitting Diodes, Woodhead, 2013
4. B E Saleh and M C Teich, Fundamentals of Photonics:, Wiley-Interscience, 1991
5. Bandyopadhay, Optical communicatoion and networks, PHI, 2014.
6. Mynbaev, Scheiner, Fiberoptic Communication Technology, Pearson, 2001.

7. Piprek, Semiconductor Optoelectronic Devices, Elsevier, 2008.
8. Franz and Jain , “Optical Communications Components and Systems”,: Narosa

DE- ECE 804 IC Technology

L-T-P-C
4-0-0-4

Course Outcomes: After the successful completion of the course the students will be able to:

1. Understand the fundamentals and areas of applications for the Integrated Circuits
2. Analyze important types of integrated circuits of day-to-day requirements.
3. Demonstrate the ability to design practical circuits that perform the desired operations.
4. Understand the differences among theoretical, practical & simulated results in integrated circuits.
5. Choose the appropriate integrated circuit modules to build a given application.

Syllabus

Unit-1 (8 Hrs)

Introduction to IC Technology: SSI, MSI, LSI, VLSI Integrated Circuits Crystal Growth and Wafer Preparation: Electronic Grade Silicon, Czochralski Crystal Growth, Silicon Shaping, Processing Considerations. Epitaxy: Vapor -Phase Epitaxy, Molecular Beam Epitaxy.

Unit-2 (8 Hrs)

Oxidation: Growth Kinetics, Thin Oxides, Oxidation Techniques and Systems, Oxides Properties. Lithography: Optical Lithography. Photo masks, Wet Chemical Etching. Dielectric and Polysilicon Film Deposition: Deposition Processes, Polysilicon, Silicon Dioxide, Silicon Nitride.

Unit-3 (9 Hrs)

Diffusion: Diffusion of Impurities in Silicon and Silicon Dioxide, Diffusion Equations, Diffusion Profiles, Diffusion Furnace, Solid, Liquid and Gaseous Sources, Sheet Resistance and its Measurement. Ion-Implantation: Ion-Implantation Technique,Implantation Equipment.

Unit-4 (8 Hrs)

Metallization: Metallization Application, Metallization Choices, Physical Vapor Deposition, Vacuum Deposition, Sputtering Apparatus. Packaging of VLSI devices: Package Types, Packaging Design Consideration

Unit-5 (8 Hrs)

VLSI Process Integration: Fundamental Considerations For IC Processing, NMOS IC Technology, CMOS IC Technology, Bipolar IC Technology, Monolithic and Hybrid Integrated Circuits, IC Fabrication.

Text/Reference Books:

1. S. M. Sze, "VLSI Technology", McGraw Hill Publication.
2. S.K. Ghandhi, "VLSI Fabrication Principles", Willy-India Pvt. Ltd
3. J. D. Plummer, M. D. Deal and Peter B. Griffin, “Silicon VLSI Technology: Fundamentals, Practice and Modelling", Pearson Education Publication.
4. Stephen A. Campbell, "Fabrication Engineering at the Micro and Nano scale", Oxford University Press.

DE-ECE 805 Fuzzy Logic and Neural Network

L-T-P-C
4-0-0-4

Course Outcomes: At the end of the course, the student will be able to:

1. Apply operations on Fuzzy sets
2. Develop Fuzzy logic controllers.
3. Apply Fuzzy relations to applications.
4. Understand the basic concepts of Neural Network.
5. Apply neural network techniques to applications.

Syllabus

Unit-1

Crisp set theory (CST): Introduction, Relations between sets, Operations on sets, Characteristic functions, Cartesian products of crisp sets, crisp relations on sets.

Fuzzy set theory (FST): Introduction, concept of fuzzy set (FS), Relation between FS, operations on FS, properties of standard operations, certain numbers associated with a FS, certain crisp sets associated with FS, Certain FS associated with given FS, Extension principle.

Unit-2

Fuzzy Logic (FL): Introduction, Three-valued logics, N-valued logics and infinite valued logics, Fuzzy logics, Fuzzy propositions and their interpretations in terms of fuzzy sets, Fuzzy rules and their interpretations in terms of FR, fuzzy inference, More on fuzzy inference, Generalizations of FL.

Unit-3

Applications: Introduction to fuzzy logic controller (FLC), Fuzzy expert systems, classical control theory versus fuzzy control, examples, working of FLC through examples, Details of FLC, Mathematical formulation of FLC, Introduction of fuzzy methods in decision making.

Unit-4

Neurophysiology: Introduction: Elementary neurophysiology-From neurons to ANNs - Neuron model McCulloch-Pitts model, Hebbian Hypothesis; limitations of single-layered neural networks.

Unit-5

Multi-Layer Feed forward Neural Networks: Multi-Layer Perceptrons. Supervised Learning. Approximation and interpolation of functions. Back-Propagation Learning law. Fast training algorithms. Applications of multilayer perceptrons: Image coding, Paint-quality inspection, Nettalk. Applications of Neural network.

Text/Reference Books:

1. M. Ganesh, Introduction to Fuzzy Sets and Fuzzy Logic, PHI, 2001.
2. G.J. Klir and B.Yuan, Fuzzy sets and Fuzzy Logic–Theory and Applications, PHI, 1997.
3. T. J. Ross, Fuzzy Logic with Engineering Applications, McGraw-Hill, 1995.

List of Open Electives		
Open Elective – I		
1.	OEC 501	Environmental Pollution and Management
2.	OEC 502	Urban and Town Planning
3.	OEC 503	**Laser System and its Application**
4.	OEC 504	**Bio- Medical Engineering**
5.	OEC 505	Industrial Engineering & Automation
6.	OEC 506	Total Quality Management
7.	OEC 507	Production Planning and Control
8.	OEC 508	Value Engineering
9.	OEC 509	Operation Research
10.	OEC 510	Graph Theory
11.	OEC 511	Computer Based Numerical and Statistical Techniques
12.	OEC 512	VLSI Circuits
Open Elective – II		
1.	OEC 601	Water Resources Conservation
2.	OEC 602	Environmental Management
3.	OEC 603	**Robotics**
4.	OEC 604	Mechatronics
5.	OEC 605	Composite Materials
6.	OEC 606	Entrepreneurship
7.	OEC 607	Mechanical System Design
8.	OEC 608	Product Development & Design
9.	OEC 609	Modeling And Simulation
10.	OEC 610	**Internet of Things**
11.	OEC 611	Electrical and Hybrid Vehicles

12.	OEC 612	**Nanoelectronics**
Open Elective – III		
1.	OEC 701	Finite Element Analysis
2.	OEC 702	Environment Impact Assessment
3.	OEC 703	**Digital System Design using VHDL**
4.	OEC 704	**Micro Electro Mechanical System**
5.	OEC 705	Non-Conventional Energy Resources
6.	OEC 706	**Nanotechnology**
7.	OEC 707	Non-Destructive Evaluation
8.	OEC 708	Introduction to Mechanical Micro Machining
9.	OEC 709	Data Science
10.	OEC 710	Big Data Analytics
11.	OEC 711	**Machine learning and Python Programming**
12.	OEC 712	**Embedded Systems**
Open Elective – IV		
1.	OEC 801	Remote Sensing And Geographic Information System
2.	OEC 802	Infrastructure Engineering
3.	OEC 803	Advance Sensors and Transducer
4.	OEC 804	**Multimedia Communication**
5.	OEC 805	Power Plant Engineering
6.	OEC 806	Optimization Methods in Engineering
7.	OEC 807	Fracture Mechanics
8.	OEC 808	Machine Tool Design
9.	OEC 809	Block chain
10.	OEC 810	Computer Vision

11.	OEC 811	Metro Systems and Engineering
12.	OEC 812	**Speech and Audio Processing**

OPEN ELECTIVE – I

OEC	ENVIRONMENTAL POLLUTION & MANAGEMENT	OEC501	3 0 0	3 CREDITS
COURSE OUTCOMES:				
CO1	Identify the impact of human on environment.			
CO2	Identify the water & thermal pollution sources. Apply the prevention of its causes.			
CO3	Identify the noise, land & air pollution sources. Apply the prevention of its causes.			
CO4	Apply the EIA			
CO5	Identify the contemporary issues.			

Unit 1

Impact of man on environment, consequence of population growth, energy problem, pollution of air, water and land, Global environmental issues.

Unit III

Air pollution: Sources and effects, meteorological aspects, control methods and equipments,

Land pollution: Types of land pollution, solid waste management-generation, storage, collection, transport, processing and disposal.

Noise pollution: Sources, effects, preventive and control measures.

Unit IV

EIA: Planning and management of environmentalimpact studies; Impact evaluation methodologies:baselinestudies, screening, scooping, checklist, overlays, Environmental impact assessment of water resources and environmental projects, Case study of power plant.

EA: Meaning, audit items, audit procedure, safety audit.

Unit V

Contemporary issues: Emission trading, discharge permits, international resource sharing issues, climate change, international environmental treaties and protocol.

Environmental legislation: Introduction to various legislations related to water, air, biodiversity, ozone depletion etc at National and International level; Institutions for governance.

References :

1. Principles of environmental studies (Ecology, economics, management and law) by C. Manoharachary and P. Jayarama Reddy, B.S.Publications.
2. Text of Environmental Engineering by P.V. Rao, Prentice Hall pvt ltd.,Delhi
3. Environmental impact assessment methodologies by Y. Ananayulu and C.A. Sastry, B.S. Publications,Hyderabad

OEC	URBAN & TOWN PLANNING	OEC 502	3 0 0	3 CREDITS
COURSE OUTCOMES:				
CO1	Understanding the urban areas.			
CO2	Apply the Urban planning.			
CO3	Apply the town & country planning.			
CO4	Understand the traffic transportation systems.			
CO5	Understanding the Development plans.			

UNIT-I

Definition and classification of urban areas - Trend of urbanization - Planning process - Various stages of the planning process - Surveys in planning. Plans - Delineation of planning areas.utility of spaces, future growth etc. Role of "Urban Planner "in planning and designing inrelation with spatial organization, utility, demand of the area and supply

UNIT-II

Plan implementation- Urban Planning agencies and their functions - Financing- Public, private, Nongovernmental organizations- Public participation in Planning. Development controlregulations. sustainability and rationality in planning, Components of sustainable urban andregional development, Emerging Concepts: Global City, inclusive city, Safe city, etc. City of the future, future of the city.

UNIT-III

Town and country planning act- Building bye-laws. Elements of City Planning, Zoning and land use, Housing. Introduction to landscaping, importance , objectives, principles, elements, Urban Planning standards Urban renewal for quality of life and livability.

UNIT-IV

Traffic transportation systems: urban road, hierarchy, traffic management, Intelligent Transport Systems. Legal Issues in Planning and Professional Practice, Concepts and contents related to planning provision regarding property rights, Concept of Arbitration, State and Central government to deal with various matters concerning Town and Country Planning. mechanism for preparation of DP: Land Acquisition Rehabilitation and Resettlement Act 2013.

UNIT-V

Types of Development plans: Master Plan, City Development Plan, Structure Plan ,housing, land use, Water Supply & sanitation, etc., Planning agencies for various levels of planning. Their organization and purpose (CIDCO-MHADA-MIDC, MMRDA/ PMRDA etc).

Reference Books:-

1.Adib Kanafani.(1983). Transportation Demand Analysis. Mc Graw Hill Series in Transportation, Berkeley.

2. Hutchinson, B.G. (1974). Principles of Urban Transport Systems Planning. Mc Graw Hill

OEC 503 Laser Systems and its Application

L-T-P-C
3-0-0-3

Course Outcomes: At the end of the course, students will demonstrate the ability to:

1. Understand quantum physics needed for describing Laser operation
2. Descibe Einstein's Coefficients and population inversion condition
3. Describe Components of Laser and explain its operating principles
4. Analyze Laser in different physical states
5. Appreciate numerous applications of Laser in Medical and Engineering field

Unit-1 (7 Hrs)
Introduction: Review of elementary quantum physics, Schrodinger equation, concept of coherence, absorption, spontaneous emission and stimulated emission processes,
Unit-2 (7 Hrs)
Equation: Relation between Einstein's A and B coefficients, population inversion, pumping, gain, optical cavities.

Unit-3 (8 Hrs)
Lasers: Main components of Laser, principle of Laser action, introduction to general lasers and their types. Three & four level Lasers, CW & Pulsed Lasers.

Unit-4 (6 Hrs)
Laser Systems: Atomic, ionic, molecular, excimer, liquid and solid state Lasers and systems, short pulse generation and Measurement.

Unit-5 (8 Hrs)
Applications: Laser applications in medicine and surgery, materials processing, optical communication, metrology and LIDAR and holography.

Text/ Reference Books:

1. K.R. Nambiar, "Laser Principles, Types and Application" New AgeInternational.
2. S. A. Ahmad, "Laser concepts and Applications" New AgeInternational.

OEC 504 Bio-Medical Engineering

L-T-P-C
3-0-0-3

Course Outcomes: At the end of semester, student will be able to:

1. Relate biological world to electronics circuit and gain knowledge about implementation of different sensors in the circuits targeted for various medical devices used for curing of human and other living beings.
2. Related biological signal with electrical concepts and implement the knowledge in development of cardio vascular respectively and nervous system related bio electronics instruments.
3. Gain basic knowledge regarding requirements of ICU, CCU and OR.
4. Gain basic understanding about medical imaging equipment Like CT scan, MRI, PET etc. and will improve the existing designs also.

Unit-1 (10 Hrs)

Electrodes, Sensors and Transducers: Signal Acquisition, Transduction, Active v/s Passive sensors, Sensor error sources, sensor terminology, signal processing, electrodes for biophysical sensing, medical surface electrodes, microelectrodes, different types of transducers.

Electrocardiography: Generation of electric currents in heart, ECG waveform, standard lead system, ECG preamplifier, ECG readout devices, ECG machines, ECG machine maintenance, faults and troubleshooting.

Unit-2 (8 Hrs)

Cardio vascular measurements and Devices: Physiological pressure measurements, B.P. measurements, Oscillometric and Ultrasonic non-invasive pressure measurements, pressure transducers, pressure amplifiers, calibrations methods, detector circuits, dilution methods, blood flow measurements. Introduction to plethysmography, phonocardiograph, defibrillators, pacemakers, heart lung machine.

Unit-3 (7 Hrs)

Respiratory system measurements and Devices: Human respiratory system, gas laws, internal respiration, external respiration, mechanics of breathing, parameters and regulations of respiration, respiratory transducers, medical gases, introduction to spirometer and artificial ventilators.

Unit-4 (10 Hrs)

Nervous system measurements and Devices: Organization of Human nervous system, cerebral angiography, cranial X-rays, brain scans, system preamplifier and specifications of EEG, EEG electrodes, EEG telemetry system, typical EEG system artifacts, faults, trouble shooting and maintenance.

ICUs, CCUs and Operating Rooms (Ors): ICU/CCU equipments, Bedside monitors, central monitoring consoles, ECG and physiological telemetry, types of surgery, OR personal, sterilization, OR equipments.

Unit-5 (11 Hrs)

Medical Laboratory Instrumentation: Blood tests, Colorimeter, flame photometer, spectrophotometer, blood cell counters, pH and blood gas analyzers, auto analyzer, dialysis machine, Electrical safety precautions, typical faults.

Medical Imaging Equipments: Basic Principles and working of various medical imaging modality: X-ray, CT Scan, MRI, PET Scan, Ultrasonography, color Doppler, Echocardiography, nuclear medical imaging.

Text/Reference Books:

1. R.S.Khandpur, Handbook of Biomedical Instrumentation, Tata McGraw Hill, New Delhi, 2003, Edition-II.
2. Cromwell L, Weibell FJ, Pfeifer EA, Biomedical Instrumentation and Measurements, 2nd Edition, PHI
3. G.S. Sawhney, Fundamentals of Biomedical Engineering, New Age Publications
4. J. J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technology",4th Edition, Prentice Hall, 2000.
5. Bruce, "Biomedical Signal Processing & Signal Modeling," Wiley, 2001.
6. Chatterjee, Biomedical Instrumentation Systems, Cengage learning 2011.

Industrial Engineering and Automation (OEC-505)

L T P C
3 0 0 3

Prerequisite: Basic Knowledge of Workshop Practice.

Course Outcomes (COs):

After completing this course a student will be able to:

1. Analyze and explain productivity concepts and measurements.
2. Explain various Industrial Layout and time study.
3. Exhibit skills towards program evaluation and review technique.
4. Analyze and perform Break even analysis.
5. Understand of High Volume Production Systems, Transfer Devices and Feeder.

Course Contents:

Unit I

Introduction: Engineering economy and costing, cost analysis, methods of depreciation, productivity concepts and measurements, job evaluation, methods of job evaluation, merit rating, wage incentive plan, types of wage incentive plans.

Unit II

Work measurement, time study,predetermined motion and time study(PMTS), work sampling, method study, micro motion study, principles of motion economy.

Unit III

Plant location, Types of Layout, Principles of Facility Layout, Objective Functions, Steps in PPC, Planning, Routing, Scheduling, Loading, Dispatching, Effectiveness of PPC.

Unit IV

PERT, CPM, Resource Allocation and GERT- Program Evaluation and Review Technique (PERT), Critical Path Method (CPM), Scheduling with Resource Constraints. Introduction to quality management, Ergonomics.

Unit V

High Volume Production Systems- Transfer Devices, Feeder classification, Construction and Applications, Automated Flow lines, Analysis of Automated Flow lines for Reliability and Efficiency, Assembly Systems, Robot Technology, Flexible Manufacturing Systems (FMS).

Textbooks:

1. Industrial Engineering by M.S. Mahajan, DhanpatRai and Co. (P) Ltd.
2. Introduction to Robotics by S.K. Saha, Tata Magraw Hill

Reference Books:

1. Introduction to Industrial System Engineering by Turner w.c. et Al 1993,Prentice Hall
2. Motion and Time Study, Design and Measurement of Work by Ralph M. Barnes, Wiley Publishers**.**
3. Project Management for Business and Technology by John M Nicholas, PHI
4. Robotics by John M Nicholas, Pearson Education.

Total Quality Management (OEC-506)

L T P C
3 0 0 3

Prerequisite: Basic Knowledge of Industrial Engineering

Course Outcomes (COs):

After completing this course a student will be able to:

1. Describe the dimensional barrier regarding Quality.
2. Summarize the Total quality principles.
3. Demonstrate the tools utilization for quality improvement. Analyze the various types of techniques are used to measure quality
4. Discover the new decision of principle in real time projects.
5. Apply the various quality systems in implementation of Total quality management.

Course Contents:

Unit I

Quality Concepts: Evolution of Quality control, concept change, TQM Modern concept, Quality concept in design.Control on Purchased Product: Procurement of various products, evaluation of supplies, capacity verification, Development of sources, procurement procedure.

Manufacturing Quality: Methods and Techniques for manufacture, Inspection and control of product, Quality in sales and services, Guarantee, analysis of claims.

Unit II

Quality Management: Organization structure and design, Quality function, DE-CEntralization, Designing and fitting organization for different types products and company, Economics of quality value and contribution, Quality cost, optimizing quality cost, seduction programme.

TQM Principles: Leadership, strategic quality planning; Quality councils- employee involvement, motivation;Empowerment; Team and Teamwork; Quality circles, recognition and reward, performance appraisal; Continuous process improvement; PDCE cycle, 5S, Kaizen; Supplier partnership, Partnering, Supplier rating & selection.

Unit III

Tools and Techniques: Seven QC tools (Histogram, Check sheet, Ishikawa diagram, Pareto, Scatter diagram, Control chart, flow chart).

Control Charts: Theory of control charts, measurement range, construction and analysis of R charts, process capability study, use of control charts, P-charts and C-charts.

Unit IV

Defects Diagnosis and Prevention: Defect study, identification and analysis of defects, corrective measure, factors affecting reliability, MTTF, calculation of reliability, Building reliability in the product, evaluation of reliability, interpretation of test results, reliability control, maintainability, zero defects, quality circle.

Unit V

IS0 and its concept of Quality Management: Quality systems, need for ISO 9000, ISO 9001-9008; Quality system- elements,documentation, Quality auditing, QS 9000, ISO 14000- concepts, requirements and benefits; TQM implementation in manufacturing and service sectors, Auditing, Taguchi method, JIT in some details.

Textbooks:

1. Total Quality Management by Mukherjee, P.N.
2. Janakiraman B. and Gopal R.K., Total Quality Management, Prentice Hall India, 2006.
3. Total Quality Management, by Dale H. Bester field, Pearson India.

Reference books:

1. Beyond Total Quality Management, Greg Bounds, McGraw Hill.
2. Bester field D.H. et al., Total quality Management, 3rd ed., Pearson Education Asia, 2006.
3. Evans J.R. and Lindsay W.M., The management and Control of Quality, 8th ed., first Indian edition, Cengage Learning, 2012.
4. Suganthi L. and Samuel A., Total Quality Management, Prentice Hall India, 2006.
5. TQM in New Product manufacturing, H. G. Menon, McGraw Hill.

Production Planning and Control (OEC-507)

L T P C

3 0 0 3

Prerequisite:

Course Outcomes (COs):

After completion of this course student will be able to:

1. Understand the role Production Planning and control activities in Manufacturing and Services.
2. Understand and perform various Forecasting techniques and problems.
3. Understand and perform various Inventory Management techniques and apply in real manufacturing scenario/How to use MRP/ERP.
4. Demonstrate various Scheduling procedures/Balancing concepts.
5. Understand and Evaluate Dispatching procedures.

Course Contents:

UNIT I

Introduction: Definitions – objectives of production planning and control functions of production planning and control-elements of production control types of production- organization of production planning and control – internal organizations department.

UNIT II

Forecasting: Importance of forecasting – types of forecasting, their uses general principles of forecasting techniques- Qualitative methods and quantitative methods.

UNIT III

Inventory management: Functions inventory- Relevant inventory cost- ABC analysis- VED Analysis- EOQ model – Inventory control systems – P- Systems and Q – Systems Introduction to MRP and ERP, LOB (Line of balance), JIT inventory, Japanese concepts.

UNIT IV

Routing: Definition **–** routing procedure- Route sheets – Bill of material factors affecting routing procedure.Schedule – definition – difference with loading. Scheduling polices – techniques, standard scheduling methods- job shop, flow shop, Line balancing, aggregate planning- methods for aggregate planning- Chase planning, expediting, control aspects.

UNIT V

Dispatching: Activities of dispatcher- Dispatching procedure - follow up – definition – reasons for existence of functions – types of follow up, applications of computer in production planning and control

Textbooks:

1. K C Jain and L N Agarwal, Production Planning and Control, 6th edition, Khanna Publishers, 2008.
2. M Mahajan, Production Planning and Control, DhanpatRai& Co., 2010.

Reference Books:

1. R Paneerselvam, Production & Operations Management, 2nd edition, PHI Publications, 2006.
2. E S Baffa and R K Sarin, Modern Production & Operation Managements, 8th edition, Wiley Publications, 2009.
3. O P Khanna, Industrial Engineering and Management, DhanpatRai& Co., 2009.
4. Samuel Eilon, Elements of Production Planning and Control, The Macmillan Company, New York.
5. S D Sharma, Operations Research, KedarnathRamnath Publishers, 1996.
6. J K Sharma, Operations Research, 4th edition, Macmillan India Limited, 2009.
7. P Ramamurthy, Production and Operations Management, New Age International Publications, 2007
8. K L Narayana, P Kannaiah and K Venkata Reddy, Machine Drawing, 3rd edition, New Age Publications, 2006.

Value Engineering (OEC-508)

L T P C

3 0 0 3

Prerequisite:

Course Outcomes (COs): After completing this course a student will be able to:

1. Understand concepts of value engineering and value analysis.
2. Understand the evaluation techniques of function and problem setting and solving systems.
3. Describe various phases involved in value engineering job plan and techniques of value engineering.
4. Understand the applications of value Analysis of management practice in different organizations.
5. Demonstrate their ability to apply value analysis in various fields.

UNIT I

Introduction to value analysis: Definition of Value, Value Analysis, Value Engineering, Value management, Value Analysis versus Value Engineering, Value Analysis versus Traditional cost reduction techniques, uses, applications, advantages and limitations of Value analysis. Symptoms to apply value analysis, Coaching of Champion concept.

Type of values: Reasons for unnecessary cost of product, peeling cost Onion concept, unsuspected areas responsible for higher cost, Value Analysis Zone, attractive features of value analysis. Meaning of Value, types of value & their effect in cost reduction. Value analysis procedure by simulation.Detailed case studies of simple products.

UNIT II

Functional cost and its evaluation: Meaning of Function and Functional cost, Rules for functional definition, Types of functions, primary and secondary functions using verb and noun, Function evaluation process, Methods of function evaluation. Evaluation of function by comparison, Evaluation of Interacting functions, Evaluation of function from available data, matrix technique, MISS technique, Numerical evaluation of functional relationships and case studies.

Problem setting & solving system: A problem solvable stated is half solved, Steps in problem setting system, Identification, Separation and Grouping of functions. Case studies.

Goods system contains everything the task requires. Various steps in problem solving, case studies.

UNIT III

Value engineering job plan: Meaning and Importance of Value Engineering Job plan. Phases of job plan proposed by different value engineering experts, Information phase, Analysis phase, Creative phase, Judgments phase, Development planning phase, and case studies. Cost reduction programs, criteria for cost reduction program, Value analysis change proposal.

Value engineering techniques: Result Accelerators or New Value Engineering Techniques, Listing, Role of techniques in Value Engineering, Details with Case examples for each of the techniques.

UNIT IV

Advanced value analysis techniques: Functional analysis system technique and case studies, Value Analysis of Management Practice (VAMP), steps involved in VAMP, application of VAMP to Government, University, College, Hospitals, School Problems etc., (service type problems).

Unit V

Total value engineering: Concepts, need, methodology and benefits.

Application of value analysis: Application of Value analysis in the field of Accounting, Appearance Design, Cost reduction, Engineering, manufacturing, Management, Purchasing, Quality Control, Sales, marketing, Material Management Etc., Comparison of approach of Value analysis & other management techniques.

Textbooks:

1. Techniques of Value Analysis and Engineering – Lawrence D. Miles - McGraw Hill Book Company - 2nd Edition.
2. Value engineering for Cost Reduction and Product Improvement – M.S. Vittal – Systems Consultancy Services – Edn.1993.
3. Value Management, Value Engineering and Cost Reduction – Edward D Heller – Addison Wesley Publishing Company-1971.

Reference books:

1. Value Analysis for Better Management – Warren J Ridge – American Management Association - Edition1969.
2. Getting More at Less Cost (The Value Engineering Way) – G. Jagannathan - Tata McGraw Hill Pub. Comp Edition1995.Value Engineering – Arther E Mudge - McGraw Hill Book Comp.- Edn1981.

Operation Research (OEC 509)

L T P C

3 0 0 3

COURSE OUTCOME:

After completion of the course students will be able to:

1. Express objective function and resource constraints in LP model in terms of decision variables and parameters.

2. Construct the initial transportation table for a trans-shipment problem and to solve a profit maximization transportation problem using suitable changes in the transportation algorithm.

3.Appreciate application of integer LP problem in several areas of managerial decision- making and to use linear programming approach to compute the value of the game when dominance rule do not apply.

4. Derive replacement policy for items whose running cost increases with time and to use various selective inventory control techniques to classify inventory items into broad categories.

5.Derive relationship among variety of performance measures using Probability Distributions and Dynamic Programming are used for Optimization.

DETAIL SYLLABUS

UNIT-1 Introduction To Linear Programming : Definition and scope of operations research (OR), OR model, Problem Formulation and Application of LPP model, Graphical LPP solution, Simplex method, Big M-method, Two phase method, Special cases in Simplex method application, Duality in Linear Programming, Dual Simplex method, Sensitivity analysis, various industrial application of Linear Programming

UNIT-2 Linear Programming Extension -Transportation Models: Formulation and Optimal solution of Transportation problem, Method of finding Initial Solution – **NWCM,, LCM, VAM**, Close loop in Transportation Table and its properties, Variation in Transportation problem – Degeneracy and its resolution, Trans Shipment models, Assignment models - Hungarian method for solving Assignment Problem, Travelling Salesman problem.

UNIT-3 Integer Programming ,Game Theory ,Sequencing and Project Management:

Integer Programming -Formulation and solution of Integer linear programming problems, Enumeration and cutting plane solution concept, Branch and Bound algorithm. **Game Theory** : Introduction, Two person Zero Sum Game, Minimax and, Maximin Principles Rules of Dominance. **Sequencing problems**- Travelling Salesman problem, Machine-scheduling problem (Job shop). **Project Management**- Objectives of **CPM** and **PERT,** Characteristic of **CPM/PERT** projects**..**

UNIT-4 Replacement and Inventory models:

Replacement Problems- Optimal age of equipment replacement, Replacement of items that fail, Individual and group replacement policies.

Inventory models- Deterministic Inventory models, Classic **EOQ** model, **EOQ** with price breaks, single item Inventory control models without/with shortage, multi-item Inventory control models with constraints, single item Inventory control models with quantity discounts.

UNIT-5 Queuing Theory and Dynamic Programming:

Queuing Theory – Structure of a Queuing system,Probability Distribution in Queuing System, classification of Queuing models - Single server Queuing models/Multi server Queuing models.

Dynamic Programming- Dynamic Programming formulations, Bellman's principle of optimality, computation in Dynamic Programming, Forward and Backward recursions.

References:

Text / Reference Books:

1. Wayne L. Winston, "Operations Research" Thomson Learning,2003.
1. **2.**Hamdy H. Taha, "Operations Research-An Introduction" Pearson Education,2003.
2. R. PanneerSeevam, "Operations Research" PHI Learning, 2008.
3. V. K .Khanna, "Total Quality Management" New Age International, 2008.
4. Rao S.S. " Optimization Theory and Applications ", Willey Eastern Limited.
5. Taha H.A., " Operation Research-An Introduction ", Macmillan.
6. J .K. Sharma," Applied Operations Research", Trinity

Graph Theory (OEC 510)

L T P C

3 0 0 3

Course outcomes:

After the course the student will have a strong background of the graph theory which has diverse applications in the area of computer science, biology, chemistry, physics & engineering.

DETAIL SYLLABUS

UNIT 1. Graphs: Graphs, Sub graphs, some basic properties, various example of graphs & their sub graphs, walks, trails, path & circuits, connected graphs, disconnected graphs and its components, various operation on graphs, unicursal line, Euler graphs, Hamiltonian paths and circuits, Hamiltonian graph, traveling salesman problem, Chinese Postman problem. Fleury's algorithm for constructing an Euler line in a graph G, directed graphs, types of directed graphs, directed paths and connectedness, circuits in digraph, Hamiltonian and Euler digraphs.

UNIT 2. Trees: Trees and its characterization, distance, eccentricity and centre, diameters, radius of a tree and pendent vertices, rooted and binary trees, spanning trees, height of a binary tree, traversing binary tree, depth-first search and breath first search in a graph. Branches and chord, rank and nulity, on counting trees, trees with directed edges, fundamental circuits, finding all spanning trees of a graph and a weighted spanning tree, minimum weight spanning tree algorithm, , Prim's, Kruskal's and Dijkstra's algorithm.

UNIT 3. Cut sets & Network flow, Planar Graphs: Cuts sets and cut vertices, some properties, all cut sets in a graph, fundamental circuits and cut sets, connectivity in a graph and separable graph.

Transportation Networks: Networks flows, Max-flow-min cut theorem.
Planar Graphs: planar graphs, region and its degree, Euler's formula, Kuratowski's theorem and its application to planarity detection of graphs,dual graphs, combinational and geometrical dual, thickness and crossings.

UNIT 4. Matrix Representation and Colouring of Graphs: Incidence matrix of graph, sub matrices of A(G), circuit matrix, cut set matrix, fundamental circuit matrix and rank of matrix B, path matrix ,adjacency matrices, adjacency matrix of a digraph and their properties .
Colouring Of Graphs : Colouring, , chromatic number, colour critical graph, chromatic partitioning, chromatic polynomials, matching, maximal matching, augmenting path, covering, minimal covering , Four colour problems, five colour theorem.

UNIT 5. Enumeration of graphs: Enumeration: types of enumeration, counting of labelled and unlabelled graphs and trees, cycle index of permutation group, Cayley's theorem, statement of Burnside's theorem, figure counting series and configuration series, Polya's Enumeration(or counting)theorem, Application of Polya's theorem in Graph Enumeration.

Text / Reference Books:

1. Deo N., Graph Theory with Applications to Engineering and Computer Science, Prentice-Hall, Inc.

2. Bondy and Murthy: Graph theory and application. Addison Wesley.
3. John M. Aldous and Robin J. Wilson: Graphs and Applications-An Introductory Approach, Springer
4. Robin J, Wilson: Introduction to Graph Theory, Addison Wesley
5.KalikaPatraj: Graph theory, S.K. Kataria& Son's, N .Delhi.

Computer based numerical and statistical techniques (OEC 511)

L T P C

3 0 0 3

Course Outcomes:

1. Gain insight about design and analysis of standard searching and sorting algorithms. Learn various algorithm Analysis techniques.
2. Able to compare between different data structures i.e., trees, heaps etc. also, pick an appropriate data structure for a design situation.
3. Learn divide and conquer, Greedyparadigms and understand and analyze when an algorithmic design situation calls for them.
4. Developing and analyzing the solutions for the problems using Dynamic programming, backtracking and Branch and bound approaches..
5. Understand NP completeness and difference between NP-Hard & NP-complete problems..

Unit 1: Introduction: Numbers and their accuracy,Mathematical preliminaries, Errors and their Computation, General error formula, Error in a series approximation.

Solution of Algebraic and Transcendental Equation:

Bisection method, Iteration method, Aitken's Δ^2 method, method of False position, Newton-Raphson method, methods of finding complex roots, Rate of convergence of Iterative methods.

Unit 2: Sorting and Order Statistics: Heapsort, Priority queues, Quicksort, Merge sort, Sorting in linear time.

Advanced Design and Analysis Techniques: Dynamic programming – Elements, Matrix-chain multiplication, longest common subsequence, Travelling Salesperson problem, Greedy algorithms – Elements, activity-selection problem, Huffman codes, task scheduling problem, Knapsack Problem, Backtracking – Elements, 8 – Queens, Graph Coloring, Hamiltonian Cycles.

Unit 3: Advanced Data Structures: Operations in B-Trees, Binomial heaps, Fibonacci heaps, data structures for disjoint sets, strings.

Unit 4: Graph Algorithms: Review of graph algorithms, topological sort, strongly connected components, minimum spanning trees – Kruskal and Prim's, Single source shortest paths, relaxation, Dijkstra's algorithm, Bellman-Ford algorithm, single source shortest paths for directed acyclic graphs.

Unit 5: P – Hard & NP – Complete problems: Basic concepts, Clique Decision problem, Node Cover decision problem, Travelling Salesperson decision problem, Introduction to approximation algorithms Planer Graph Coloring, Maximum programs stored problem.

Suggested reference books:

1. Cormen, Leiserson and Rivest: Introduction to Algorithms, 2/e, PHI.
2. Horowitz, Sahni, and Rajasekaran: Fundamentals of Computer Algorithms, Second Edition, Universities Press, Hyderabad.
3. Aho, Hopcroft, and Ullman: The Design and Analysis of Computer Algorithms, Addison Wesley.

VLSI Circuits (OEC 512)

L T P C
3 0 0 3

Course Outcomes: At the end of this course students will demonstrate the ability to	
CO1	Comprehend IC Fabrication Techniques
CO2	Analyse and design MOSFET logic circuits
CO3	Analyse and design CMOS logic circuits
CO4	Design Read Only Memory, Random Access Memory
CO5	Design Adders, multipliers

UNIT-I

Material Preparation- Purification, Crystal growth (CZ and FZ process), wafer preparation Thermal Oxidation- Growth mechanisms, Dry and Wet oxidation, Deal Grove model.

Diffusion- Fick's Laws, Diffusion with constant surface concentration and from a constant source, diffusion techniques.

Ion implantation-Technique, Range Theory, annealing

UNIT-II

Epitaxy: Vapour phase epitaxy and molecular beam epitaxy

Lithography- Photo lithographic sequence, Electron Beam Lithography, Etching and metal deposition

Methods of isolation, Circuit component fabrication: transistor, diodes, resistors, capacitors, N-well CMOS IC Fabrication Sequence

UNIT-III

CMOS inverters- DC characteristics, switching characteristics, power dissipation

Layout Design rules, Stick Diagram and layout of CMOS Inverter, two input NAND and NOR gates

MOSFET Logic Design -Pass transistor logic, Complementary pass transistor logic and transmission gate logic, realization of functions

UNIT-IV

Read Only Memory- 4x4 MOS ROM Cell Arrays (OR,NOR,NAND)

Random Access Memory – SRAM-Six transistor CMOS SRAM cell, DRAM –Three transistor and One transistor Dynamic Memory Cell

Sense amplifiers – Differential Voltage Sensing Amplifiers Introduction to PLDs and FPGAs, Design of PLAs

UNIT-V

Adders - Static adder, Carry-By pass adder, Linear Carry- Select adder, Square- root carry- select adder

Multipliers - Array multipliers

Text Books:

1. John P Uyemura, Introduction to VLSI Circuits and Systems, Wiley India, 2006

2. S.M. SZE, VLSI Technology, 2/e, Indian Edition, McGraw-Hill,2003

References:

1. Jan M.Rabaey, Digital Integrated Circuits- A Design Perspective, Prentice Hall, Second Edition, 2005.

2. Neil H.E. Weste, Kamran Eshraghian, Principles of CMOS VLSI Design- A Systems Perspective, Second Edition. Pearson Publication, 2005

3. Razavi - Design of Analog CMOS Integrated Circuits,1e, McGraw Hill Education India Education, New Delhi, 2003.

4. Sung –Mo Kang & Yusuf Leblebici, CMOS Digital Integrated Circuits- Analysis & Design, McGraw-Hill, Third Ed., 2003.

5. Yuan Taur&Ning, Fundamentals of Modern VLSI Devices, Cambridge University Press, 2008

OPEN ELECTIVE –II

OEC	WATER RESOURCES CONSERVATION	OEC 601	3 0 0	3 CREDITS
COURSE OUTCOMES:				
CO1	Explain water hydrology and environmental influence.			
CO2	Outline the concepts of Artificial Ground Water Recharge.			
CO3	Learn the Concept of Water Harvesting.			
CO4	Explain Reuse & Recycle of Waste Water and Watershed Management.			

UNIT-I

Ground and Surface Water Utilization- Historical background, Hydrologic Cycle, Water Budget, Ground Water level fluctuations and Environmental influence.

UNIT-II

Artificial Ground Water Recharge: Concept & methods of artificial ground water recharge, recharge mounds & induced recharge, wastewater recharge for reuse, Water Spreading, Farm Ponds and Percolation Tanks.

UNIT-III

Water Harvesting: Rainwater harvesting, Catchment Harvesting, Harvesting Structures, Soil Moisture Conservation, Check Dams.

UNIT-IV

11 | Page

Reuse & Recycle of Waste Water: Types of reuse, Application of treated waste water, Purity of reclaimed water, Guidelines and Regulations, New technologies used in recycling of Waste Water.

UNIT-V

Watershed management- Introduction, Concept of watershed Management, Watershed Management policies and decision making.

REFERENCES

1. Ramakrishnan S.(1996),"Ground water", Scitech Publications, 2nd Edition.
2. Todd D.K. & Mays L. F.(2006),"Groundwater Hydrology", John Wiley and sons, 2nd Edition.
3. Murthy J.V.S.(1998), “Watershed Management”, New Age International Publishers, 2nd Edition.
4. Murthy V.V.N.(2013), “ Land and Water Management”, Kalyani Publications, 6th Edition.
5. US Environment Protection Agency, 1992. “Guidelines for Water Reuse”.

0EC	ENVIRONMENTAL MANAGEMENT	OEC 602	3 0 0	3 CREDITS
COURSE OUTCOMES:				
CO1	Identify the various environmental issues.			
CO2	Apply Environmental impact assessment.			
CO3	Apply the Environmental policies & technology for environment management.			
CO4	Identify the Contemporary issues.			
CO5	Apply the Environmental legislation.			

Unit I

Introduction: Need for environmental awareness, protection of natural and manmade systems, Impact of man on environment.

Emerging global environmental issues: Population growth, climate change and global warming effects, aid rain, ozone layer depletion, urbanization, automobile pollution

Unit II

EIA: Planning and management of environmental impact studies; Impact evaluation methodologies: base line studies, screening, scooping, checklist, overlays, Environmental impact assessment of water resources and environmental projects, Case study of power plant, Hydro power plant

EA: Meaning, audit items, audit procedure, safety audit.

Unit III

Sustainable development, Environmental economics, environmental policy in planned, mixed and market economies,

Emerging technologies for environmental management; Life cycle analysis- methodology, tools and problems, Concept of ISO and ISO 14000; Environmental cost benefit analysis, Decision methods for evaluation of alternatives, Environment risk assessment, Environmental valuation: Approaches to valuation.

Unit IV

Contemporary issues: Emission trading, discharge permits, international resource sharing issues, international environmental treaties and protocol.

Unit V

Environmental legislation: Introduction to various legislations related to water, air, biodiversity, ozone depletion etc at National and International level; Issues involved in the enforcement of environmental legislation, Initiatives by NGO's, Initiatives by Governments, CPCB, Other institutions ofgovernance.

Unit II

Water pollution: Sources and classification of water pollutants, wastewater treatment, control strategies, Eutrophication of lakes, self purification capacity of streams. Waste load allocation.

Thermal pollution: Sources, effects and control measures.

References :

- Principles of environmental studies (Ecology, economics, management and law) by C. Manoharachary and P. Jayarama Reddy, B.S.Publications.
- Environmental Impact Assessment Methodologies by Y. Ananayulu and C.A. Sastry, B.S.

OEC 603 Robotics

L-T-P-C
3-0-0-3

Course Outcomes: After the completion of this course, the students will be able to:

1- Understand the basics of robotic systems and different types of robots.
2- Perform kinematic and dynamic analyses with simulation.
3- Know about different types of sensors and robotic eye: geometry of image formation.
4- Know different types of actuators and grippers in robotics.
5- Select a robotic system for given industrial application.

Unit-1 (8 Hrs)

Introduction to Robotics: Types and components of a robot, Classification of robots,Different types of joints are used in robots, Kinematics systems, Definition of mechanisms and manipulators, Degrees of Freedom.

Unit-2

Robot Kinematics: Kinematic Modelling: Translation and Rotation Representation, Coordinate transformation, DH parameters, Forward and inverse kinematics, Jacobian, Singularity,

Dynamic Modelling: Forward and inverse dynamics, Equations of motion using Euler-Lagrange formulation, Newton Euler formulation.

Unit-3

Sensor: Contact and Proximity, Position, Velocity, Force, Tactile etc., Introduction to Cameras, Camera calibration, Geometry of Image formation, Vision applications in robotics.

Unit-4

Robot Actuation and gripper Systems: Types of Actuators: Electric, Hydraulic and Pneumatic. **Transmission:** Gears, Timing Belts and Bearings, Parameters for selection of actuators, grippers.

Unit-5

Robot Control: Basics of control: open loop- closed loop, Transfer functions, Control laws: P, PD, PID, Linear and Non-linear controls, Application of robotics systems: defence, medical, industries, etc., Robotics and Automation for Industry 4.0, Robot safety and social robotics.

Text/Reference Books:

1- Introduction to Robotics : J. Craig , Pearson
2- Robot Dynamics and Control, Spong&Vidyasagar, Mc Graw Hill
3- Robotics Engineering : R. Klafter, PHI - Robotics : Subir K Saha , McGrawHill
4- Industrial Robotics : M. P. Groover, Ashish Dutta , McGraw Hill

OEC 604 Mechatronics

L-T-P-C
3-0-0-3

Course Outcomes: After the successful completion of the course the students will be able to:

1. Identification of key elements of mechatronics system..
2. Understanding the concept of signal processing and use of interfacing systems such as ADC, DAC, digital I/O.
3. analyze the Interfacing of Sensors, Actuators using appropriate DAQ micro-controller
4. Understanding the concept of Time and Frequency domain analysis of system model (for control application)
5. Understanding the concept of PID control implementation on real time systems

Unit-1

Introduction: Introduction, scope and applications of Mechatronics systems. Process control automation, FMS and CNC Machines. MEMS: Basics of Micro- and Nanotechnology, microprocessor-based controllers and Microelectronics.

Unit-2

Introduction to Sensors: Linear and Rotational Sensors, Acceleration, Force, Torque, Power, Flow and Temperature Sensors, Light Detection, Image, and Vision Systems, Integrated Micro-sensors,

Introduction to Actuators: Electro-mechanical Actuators, Electrical Machines, Piezoelectric Actuators, Hydraulic and Pneumatic Actuation Systems, MEMS: Micro-transducers Analysis, Design and Fabrication.

Unit-3

Electronics elements in mechatronics, conductors, insulators and semiconductors, passive electrical components, resistors, capacitor and inductor, transformer, active elements, semiconductor devices, transistors and integrated circuits, digital electronics components like logic gates, flip-flops, shift register, multiplexer and counter. Computing elements in mechatronics, analog computer, timer, analog to digital converter, digital to analog converter,

Unit-4

System modeling and analysis, control system concepts, transfer function of physical systems, block diagrams representation of systems, transfer function of a system, standard input signals, time response of a first to a step input, frequency response analysis, automatic control systems,

Unit-5

Design of Mechatronics systems: Introduction of mechatronics systems: Home appliances, ABS (anti-lock braking system) and other areas in automotive engineering, Elevators and escalators

Data Acquisition and related Instrumentation: Introduction to Data Acquisition Measurement Techniques: Sensors and Transducers, Quantizing theory, Analog to Digital Conversion, Digital to

Analog (D/A) conversation, Signal Conditioning. Real time Instrumentation: Computer-Based Instrumentation Systems, Data Recording and Logging.

Text/Reference books:

1. Bolton, W., "Mechatronics: Electronic Control Systems in Mechanical and 2011 Electrical Engineering
2. Ramachandran K. P., Vijayaraghavan G. K., Balasundaram M.S. "Mechatronics: Integrated Mechanical Electronic Systems", Wiley
3. A Kuttan, "Introduction to Mechatronics, Oxford University Press, 2010.
4. Mechatronics HMT Hand Book, Tata McGraw Hill.
5. Alciatore and Histand, "Introduction to Mechatronics an Measurement Systems", Tata McGraw Hill.
6. Smaili and Mrad, "Mechatronics: Integrated Technologies for Intelligent Machines" Oxford
7. Mahalik N.P., "Mechatronics: Principles, Concepts and applications", Tata McGraw Hill.

Composite Materials (OEC 605)

L T P C

3 0 0 3

Prerequisite: Basic Knowledge of Materials Science.

Course Outcomes (COs):

1. Knowledge of the different types of engineering materials.
2. Knowledge of the types of reinforcements and fibers.
3. Understand the various types of composites used in engineering and their properties.
4. Describe the processing of composite materials and manufacturing techniques.
5. Understand and analyze the various methods of testing the composites.

Course Contents:

UNIT I

Introduction: Classifications of Engineering Materials, Concept of composite materials, Matrix materials, Functions ofa Matrix, Desired Properties of a Matrix, Polymer Matrix (Thermoset sand Thermoplastics), Metalmatrix, Ceramic matrix, Carbon Matrix, Glass Matrix etc.

UNIT II

Types of Reinforcements/Fibers: Role and Selection of reinforcement materials, Types of fibers, Glass fibers, Carbon fibers, Aramid fibers, Metal fibers, Alumina fibers, Boron Fibers, Silicon carbide fibers, Quartz and Silica fibers, Multiphase fibers, Whiskers, Flakes etc. Mechanical properties of fibres. Material properties that can be Improved by forming a composite material and its engineering potential.

UNIT III

Various types of composites: Classification based on Matrix Material: Organic Matrix composites, Polymer matrix composites (PMC),Carbon matrix Composites or Carbon-Carbon Composites, Metal matrix composites (MMC), Ceramicmatrix composites (CMC);Classification based on reinforcements: Fiber Reinforced Composites, FiberReinforced Polymer(FRP) Composites, Laminar Composites, Particulate Composites.

UNIT IV

Fabrication methods: Processing of Composite Materials: Overall considerations, Auto clavecuring, Other ManufacturingProcesses like filament welding, compression moulding, resin transplant method,

pultrusion, pre-peglayer, Fiber-only performs, Combined Fiber-Matrix performs, Manufacturing Techniques: Tooling andSpecialty materials, Release agents, Peelplies, release films and fabrics, Bleeder and breather plies, bagging films, maximum stress and strain criteria, Von Mises Yield criterion for isotropic materials.

UNIT V

Testing of Composites and Analysis: Mechanical testing of composites, tensile testing, Compressive testing, Intra-laminar shear testing, Inter-laminar shear testing, Fracture testing etc.Analysis of laminated plates- equilibrium equations of motion, energy formulation, static bending analysis, buckling analysis, free vibrations, natural frequencies.

Text Books:

1. Mechanical Metallurgy, by G. Dieter, McGraw Hill.
2. Engineering Materials: Polymers, Ceramics and Composites, by A.K Bhargava Prentice Hall India.
3. Analysis and Performance of Fiber Composites, by Agarwal, McGraw Hill.

Reference Books:

1. Materials characterization, Vol. 10, ASM hand book.
2. Thermal Analysis of Materials, by R.F. Speyer, Marcel Decker.
3. Engineering Mechanics and Composite Materials, by Daniels, Oxford University Press.
4. Material Science and Engineering (SIE) with CD, by Smith, McGraw Hill.
5. Gibson R.F. Principles of Composite Material Mechanics, second edition, McGraw Hill, 1994.

Entrepreneurship (OEC 606)

L T P C
3 0 0 3

Prerequisite: Basic Knowledge of industrial management.

Course Outcomes (COs):

1. Understand entrepreneurship and its related theory and government policies
2. Understand variousBusiness Enterprises and Ownership Structure
3. Prepare project report and able to understand project evaluation method.
4. Understand various strategies and policies in management and enterprises.
5. Understand Institutional support towards the development of entrepreneurship.

Course Contents:

Unit I

Entrepreneurship: Definition, requirements to be an entrepreneur, entrepreneur and intrapreneur, entrepreneur and manager, growth of entrepreneurship in India, women entrepreneurship, rural and urban entrepreneurship.

Entrepreneurial Motivation: motivating factors, motivation theories-Maslow's Need Hierarchy Theory, McClelland's Acquired Need Theory, government's policy actions towards entrepreneurial motivation, entrepreneurship development programme.

Unit II

Business Enterprises and Ownership Structure Small scale, medium scale and large scale enterprises, role of small enterprises in economic development; proprietorship, partnership, companies and co-operatives firms: their formation, capital structure and source of finance.

Unit III

Project Management: Identification and selection of projects; project report: contents and formulation, concept of project evaluation, methods of project evaluation: internal rate of return method and net present value method.

Unit IV

Management of Enterprises: Strategy & policy, introduction to human resource management, marketing strategies, financial management & strategies: raising and managing capital, shares, debentures and bonds, cost of capital; break- even analysis.

Unit V

Institutional Support and Policies: Institutional support towards the development of entrepreneurship in India: Institutional framework, venture capitalist; technical consultancy organizations (TCOs), government policies for small scale enterprises.

Text Books:

1. Khanka, S S. 'Entrepreneurial Development', S Chand & Company Ltd. New Delhi.
2. Desai, Vasant, 'Project Management and Entrepreneurship', Himalayan Publishing House, Mumbai, 2002.
3. Gupta and Srinivasan, 'Entrepreneurial Development', S Chand & Sons, New Delhi.

Reference Books:

1. Ram Chandran, 'Entrepreneurial Development', Tata McGraw Hill, New Delhi
2. Saini, J. S. 'Entrepreneurial Development Programmes and Practices', Deep & Deep Publications (P), Ltd.
3. Holt, Davis, 'Entrepreneurship: New Venture Creations, PHI.

Mechanical System Design (OEC 607)

L T P C

3 0 0 3

Prerequisite: Basic Knowledge of Industrial Engineering.

Course Outcomes (COs):

After completing this course a student will be able to:

1. Understand the attributes characterizing a system and case study.
2. Explain the system modelling and case study compound bar system.
3. Differentiate and understand the graph modelling, graph analysis and materials handling systems.
4. Understand the method for optimization model with single system.
5. Justify the inventory control in production plant.

Course Contents:

UNIT I

Engineering process and System Approach Basic concepts of systems, Attributes characterizing a system, types of system, Application of system concepts, Advantages of system approach, Problems concerning systems, Concurrent engineering, A case study-Viscous lubrication system in wire drawing.

Problem Formulation: Nature of engineering problems, Need statement, hierarchical nature of systems, hierarchical nature of problem environment, problem scope and constraint, A case study: heating duct insulation system, high speed belt drive system.

UNIT II

System Theories: Introduction, System Analysis, Black box approach, state theory approach, component integration approach, Decision process approach, A case study- automobile instrumentation panel system.

System modeling Introduction, Model types and purpose, linear systems, mathematical modeling, concepts, A case study compound bar system.

UNIT III

Graph Modeling and Analysis Graph Modeling and analysis process, path problem, Network flow problem, A case study: Material handling system.

Optimization Concepts Optimization processes, Selection of goals and objectives-criteria, methods of optimization, analytical, combinational, subjective. A case study: aluminum extrusion system.

UNIT IV

System Evaluation Feasibility assessment, planning horizon, time value of money, Financial analysis, A case study: Manufacture of maize starch system. 4 Calculus Method for Optimization Model with single decision variable, model with two decision variables, model with equality constraints, model with inequality constraints, A case study: Optimization of an insulation system.

UNIT V

Decision Analysis Elements of a decision problem, decision making, under certainty, uncertainty risk and conflict probability, density function, Expected monetary value, Utility value, Baye's theorem, A case study: Installation of machinery. 4 System Simulation Simulation concepts, simulation models, computer application in simulation, spread sheet simulation, Simulation process, problem definition, input model construction and solution, limitation of simulation approach, A case study: Inventory control in production plant.

Text Books:

1. Engineering Design, by Dieter, McGraw Hill.
2. Optimization Techniques-SS Rao.
3. Design Engineering-JR Dixon, TMH, New Delhi.
4. Engineering Design-Robert Matousck, Blackie and son ltd. Glasgow.

Reference Books:

1. An Introduction to Engineering Design Method-V Gupta and PN Murthy, TMH, New Delhi.
2. Design and Planning of Engineering systems-DD Reredith, KV Wong, RW Woodhead, and RR Worthman, Prentice Hall Inc., Eaglewood Cliffs, New Jerse.
3. System Analysis and Project Management-Devid I Cleland, William R King, McGraw Hill.

Product Design and Development (OEC 608)

L T P C

3 0 0 3

Prerequisite:

Course Outcomes (COs):

After completing this course a student will be able to:

1. Understand how to create new product based on mechanical design engineering.
2. Understand all mechanical aspects of product design by incorporating concept, creativity, structural, manufacturing, esthetic etc.
3. Solve open-ended problem belongs to design engineering that meet the requirements.
4. Understand various product designing methods.
5. Understand human factors and cost evaluation in industrial design concepts.

Course Contents:

Unit I

Design Fundamentals:

The importance of engineering design – types of design –the design process – relevance of product lifecycle issues in design –designing to codes and standards- societal considerations in engineering design –generic product development process – various phases of product development-planning for products –establishing markets- market segments- relevance of market research.

Unit II

Customer oriented design & Societal Considerations: Identification of customer needs- customer requirements- Quality Function Deployment Product Design Specifications- Human Factors in Design – Ergonomics and Aesthetics. Societal consideration - Contracts – Product liability – Protecting intellectual property – Legal and ethical domains – Codes of ethics - Ethical conflicts – Environment responsible design-future trends in interaction of engineering with society.

Unit III

Material selection processing and Design: Material Selection Process – Economics – Cost Vs Performance – Weighted property Index – Value Analysis – Role of Processing in Design – Classification of Manufacturing Process – Design for Manufacture – Design for Assembly –Designing for castings, Forging, Metal Forming, Machining and Welding – Residual Stresses – Fatigue, Fracture and Failure.

Unit IV

Design Methods: creativity and problem solving- creative thinking methods- generating design concepts - systematic methods for designing –functional decomposition – physical decomposition – functional representation – morphological methods-TRIZ- axiomatic design. Decision making theory- utility theory –decision trees –concept evaluation methods.

Unit V

Industrial Design concepts: Human factors design –user friendly design – design for serviceability – design for environment – prototyping and testing – cost evaluation –categories of cost –overhead costs – activity based costing – methods of developing cost estimates – manufacturing cost –value analysis in costing.

Text books:

1. Product Design & Manufacturing by A. K. Chitab& R. C. Gupta, PHI (EEE).
2. Product Design and Development by Karl T Ulrich, Steven D. Eppinger.
3. Product Design, by Kevin Otto, Kristin wood, Pearson Education Inc.

Reference books:

1. The Technology of Creation Thinking by R.P. Crew ford, Prentice Hall.
2. The Art of Thought by Grohem Walls, Bruce & Co., New York.
3. Product Design & Decision Theory by M.K. Starr, Prentice Hall.
4. Human Factor Engg. byMccormick E.J., McGrawHill.
5. Engineering: An Introduction to Creative profession by G.C. Beakley, H.W. Leach, Macmillan.
6. Industrial Design In Engineering – A marriage of Techniques by Charles H.Flurscheim, The Design Council - London.
7. Quality Control & Reliability Analysis by Bijendra Singh, Khanna Publications.

MODELING AND SIMULATION (OEC 609)

L T P C

3 0 0 3

Course Outcomes:

Upon completion of the subject, students will be able to:

CO1: Understand the basics of simulation modeling and replicating the practical situations in organizations.

CO2: Realize Concepts in Discrete-Event Simulation and analyze and develop a number of simulation softwares.

CO3: understand and simulate various statistical and mathematical models

CO4: Generate random numbers and random variates using different techniques.

CO5: Analyze simulation data using input modelling as well as Understand Verification and Validation of simulation model.

Detail content

Unit 1: Introduction- advantages and disadvantages of simulation, application areas in communication, computer and software design, systems and systems environment, components of a system, discrete and continuous systems, model of a system, types of models, discrete-event simulation, steps in a simulation study. Simulation Examples- Simulation of queueing systems, on-demand and inventory systems, simulation for reliability analysis etc.

Unit 2: General Principles: Concepts in Discrete-Event Simulation, List Processing: properties and operations, data structures and dynamic allocation, techniques. **Simulation Software:** Selection of Simulation Software, review of some existing softwares like: Arena, AutoMod, Extend, Flexsim, Micro Saint, ProModel, Quest, SIMUL8, WITNESS etc., Experimentation and Statistical-Analysis Tools.

Unit 3: Statistical Models in Simulation: Useful Statistical Models, Discrete Distribution s, Continuous Distributions, Poisson Process, Empirical Distributions. **Queuing Models:** Characteristics of Queuing systems, Queuing Notation, Long Run Measures of performance of Queuing Systems, Steady State Behavior of infinite Population Markovian Models, Steady State Behavior of finite Population Models, Networks of Queues.

Unit 4: Random Number Generation: Properties of Random Numbers, Generation of Pseudo-Random Numbers, Techniques for Generating Random Numbers, Tests for Random Numbers, Inverse transform Techniques, Convolution Methods, and Acceptance –Rejection Techniques.

Unit 5:Input Modeling: Data collection, Identifying the Distribution with Data: Histograms, Selection of the Appropriate Family of Distributions, Quantile-Quantile Plots. Parameter Estimation:

Sample Mean and Sample Variance and various biased and unbiased Estimators. Goodness of Fit Tests, Multivariate and Time-Series Input Models .**Verification and Validation of Simulation Models:** Model Building, Verification & Validation, Verification of simulation Models, Calibration & Validation of Models.

Suggested Readings/ Books:

1. Jerry Banks, John S. Carson II, Barry L. Nelson and David M. Nicol, Discrete-Event System and Simulation, Prentice Hall of India, New Delhi, 2005.

2. Deo Narsingh, "System Simulation with Digital Computers", PHI, New Delhi 1993.

3. Gordon G, "System Simulation", PHI 2nd Edition 1998.

4. Gabriel A. Wainer, Discrete-event modeling and simulation: a practitioner's approach, CRC Press, 2009.

5. K S Trivedi, "Probability and Statistics with Reliability, Queuing and Computer Science Application", PHI

6. Kleinrock, L.: Queuing Systems Vol.I, Vol.II, Wiley & Sons, London, 1975

INTERNET OF THING (OEC 610)

L T P C

3 0 0 3

Course Outcomes:-

CO1:-To understand the fundamental concepts of IoT and apply them.

CO2:-To know the different hardware's used to embed them with IoT for the development of embedded applications.

CO3:-To learn the networking and communication aspects in IoT and analysis of different protocol used in IoT.

CO4:-Design and develop an application of IOT using ardunio platform.

CO5:-To comprehend the challenges faced for the development of an IoT application.

Unit I: Internet of Things (IoT): Vision, Definition, Conceptual Framework, Architectural view, technology behind IoT, Sources of the IoT, M2M Communication, IoT Examples . Design Principles for Connected Devices: IoT/M2M systems layers and design standardization, communication technologies, data enrichment and consolidation, ease of designing and affordability.

Unit II: Hardware for IoT: Sensors, Digital sensors, actuators, radio frequency identification (RFID) technology, wireless sensor networks, participatory sensing technology. Embedded Platforms for IoT: Embedded computing basics, Overview of IOT supported Hardware platforms such as Arduino, NetArduino, Raspberry pi, Beagle Bone, Intel Galileo boards and ARM cortex.

Unit III: Network & Communication aspects in IoT: Wireless Medium access issues, MAC protocol survey, Survey routing protocols, Sensor deployment & Node discovery, Data aggregation & dissemination

Unit IV: Programming the Ardunio: Ardunio Platform Boards Anatomy, Ardunio IDE, coding, using emulator, using libraries, additions in ardunio, programming the ardunio for IoT.

Unit V: Challenges in IoT Design challenges: Development Challenges, Security Challenges, Other challenges IoT Applications : Smart Metering, E-health, City Automation, Automotive Applications, home automation, smart cards, Communicating data with H/W units, mobiles, tablets, Designing of smart street lights in smart city.

References:

1.OlivierHersent,DavidBoswarthick, Omar Elloumi"The Internet of Things key applications and protocols", willey

2. Jeeva Jose, Internet of Things, Khanna Publishing House

3. Michael Miller "The Internet of Things" by Pearson

4. Raj Kamal "INTERNET OF THINGS", McGraw-Hill, 1ST Edition, 2016

5. ArshdeepBahga, Vijay Madisetti" Internet of Things(A hands on approach)" 1ST edition, VPI publications,2014

6. Adrian McEwen,HakinCassimally "Designing the Internet of Things" Wiley India

Electrical and Hybrid Vehicles (OEC 611)

L T P C
3 0 0 3

Course Outcomes: At the end of this course students will demonstrate the ability to	
CO1	Understand the models used to describe hybrid vehicles and their performance.
CO2	To comprehend electric and hybrid drive train topologies
CO3	To realize different possible ways of energy storage
CO4	Understand the different strategies of energy management

UNIT I Introduction

Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, mathematical models to describe vehicle performance.

Introduction to Hybrid Electric Vehicles: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies.

Hybrid Electric Drive-trains: Basic concept of hybrid traction, introduction to various hybrid drive train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.

UNIT II Electric Trains

Electric Drive-trains: Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis. Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency

UNIT III Energy Storage

Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices. Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications, supporting subsystems

UNIT IV Energy Management Strategies

Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different

energy management strategies, implementation issues of energy management strategies. Case Studies: Design of a Hybrid Electric Vehicle (HEV), Design of a Battery Electric Vehicle (BEV).

Text / References:

1. A. K. Sawhney, "A Course in Electrical Machine Design", DhanpatRai and Sons, 1970.

2. M.G. Say, "Theory & Performance & Design of A.C. Machines", ELBS London.

3. S. K. Sen, "Principles of Electrical Machine Design with computer programmes", Oxford and IBH Publishing, 2006.

4. K. L. Narang, "A Text Book of Electrical Engineering Drawings", SatyaPrakashan, 1969.

5. A. Shanmugasundaram, G. Gangadharan and R. Palani, "Electrical Machine Design Data Book", New Age International, 1979.

6. K. M. V. Murthy, "Computer Aided Design of Electrical Machines", B.S. Publications, 2008.

7. Electrical machines and equipment design exercise examples using Ansoft's Maxwell 2D machine design package.

Nano-electronics (OEC 612)

L T P C
3 0 0 3

Course Outcomes: At the end of this course students will demonstrate the ability to	
CO1	Understand various concepts of nano-technology
CO2	Comprehend the processes involved in making nano components and material
CO3	Leverage advantages of the nano-materials and appropriate use in solving practical problems

UNIT I

Introduction to nanotechnology, meso structures, Basics of Quantum Mechanics: Schrodinger equation, Density of States.

UNIT II

Particle in a box Concepts, Degeneracy- Band Theory of Solids. KronigPenny Model. Brillouin Zones.

UNIT III

Shrink-down approaches: Introduction, CMOS Scaling, The nanoscale MOSFET, Finfets, Vertical MOSFETs, limits to scaling, system integration limits (interconnect issues etc.),

UNIT IV

Resonant Tunneling Diode, Coulomb dots, Quantum blockade, Single electron transistors,Carbon nanotube electronics, Bandstructure and transport, devices, applications, 2D semiconductors and electronic devices, Graphene, atomistic simulation

Text/ Reference Books:

1. G.W. Hanson, Fundamentals of Nanoelectronics, Pearson, 2009.

2. W. Ranier, Nanoelectronics and Information Technology (Advanced Electronic Materialand Novel Devices), Wiley-VCH, 2003.

3. K.E. Drexler, Nanosystems, Wiley, 1992.

4. J.H. Davies, The Physics of Low-Dimensional Semiconductors, Cambridge University Press, 1998.

5. C.P. Poole, F. J. Owens, Introduction to Nanotechnology, Wiley, 2003

OPEN ELECTIVE –III

PEC	Finite Element Analysis	OEC 701	3 0 0	3 CREDITS
COURSE OUTCOMES:				
CO1	Develop the ability to solve complex problems using finite no of elements by any standard FEM software or even by self developed programs.			
CO2	Implement numerical methods to solve mechanics of solids problems.			
CO3	Formulate and Solve axially loaded bar Problems.Formulate and analyze truss and beam problems.			
CO4	Implement the formulation techniques to solve two-dimensional problems using triangle and quadrilateral elements.			
CO5	Formulate and solve Axi-symmetric and heat transfer problems.			

UNIT - I

Introduction to Finite Element Analysis: Introduction Basic Concepts of Finite Element Analysis Introduction to Elasticity Steps in Finite Element Analysis
Finite Element Formulation Techniques: Virtual Work and Variational Principle, Galerkin Method, Finite Element Method: Displacement Approach, Stiffness Matrix and Boundary Conditions

UNIT - 2

Element Properties: Natural Coordinates, Triangular Elements, Rectangular Elements, Lagrange and Serendipity Elements, Solid Elements, Iso parametric Formulation, Stiffness Matrix of Iso parametric Elements, Numerical Integration: One Dimensional. Numerical Integration: Two and Three dimensional

UNIT - 3

Analysis of Frame Structures: Stiffness of Truss Members, Analysis of Truss, Stiffness of Beam Members, Finite Element Analysis of Continuous Beam, Plane Frame Analysis, Analysis of Grid and Space Frame

UNIT – 4

FEM for Two and Three Dimensional Solids: Constant Strain Triangle, Linear Strain Triangle, Rectangular Elements, Numerical Evaluation of Element Stiffness, Computation of Stresses, Geometric Nonlinearity and Static Condensation

UNIT - 5

Axi symmetric Element: Finite Element Formulation of Axi symmetric Element, Finite Element Formulation for 3 Dimensional Elements Introduction to Plates and Shells

Text Book:

- C.S.Desai&J.F.Abel Introduction to Finite Element Method, CBS Publishers & Distributors – Volume 58, Issue 1 (2001). Reference Books:
- O.C.Zienkiewicz Finite Element Method for Engineers and scientists McGraw-Hill (2013). □ K.J.Bathe&E.L.Wilson Numerical Methods in Finite Element Analysis – (2014).
- S.S. Rao Finite Element Method in Engineering Butterworth-Heinemann (2011)

OEC	Environmental Impact Analysis	OEC 702	3 0 0	3 CREDITS
COURSE OUTCOMES:				
CO1	Understand various EIA factors. Learn the basics relationship of Environment Impact Analysis			
CO2	Understand the EIA methodologies. Learn different aspects of Environmental Audit			
CO3	Understand the Different Environmental Management Plan			
CO4	Understand the concept of Ecological Foot Print and Carbon Trading			

Unit I

Environmental impact assessment (EIA), definitions and concepts, rationale and historical development of EIA, EIA in Civil Engineering,

Unit II

Initial environmental examination, environmental impact statement, environmental appraisal, environmental impact factors and areas of consideration, measurement of environmental impact, organization, scope and methodologies of EIA, status of EIA in India

Unit III

Environmental Management:- principles, problems and strategies; Review of political, ecological and remedial actions; future strategies; multidisciplinary environmental strategies, the human, planning, decision-making and management dimensions.

Unit IV

Environmental audit, definitions and concepts, partial audit, compliance audit, methodologies and regulations; introduction to ISO and ISO 14000; Life cycle assessment; Triple bottom line approach; Industrial Ecology; Ecological foot printing; Carbon trading; Sustainable development

Reference/ Text Books:

- Rau, G.J. and Wooten, C.D., Environmental Impact Analysis Handbook, New York: McGraw Hill; 1980.
- Canter R.L. "Environmental Impact Assessment" New Delhi: McGraw Hill Inc.; 1996.
- Shukla S.K. and Srivastava, P.R., "Concepts in Environmental Impact Analysis", New Delhi: Common Wealth Publishers; 1992.

OEC 703 Digital System Design using VHDL

L-T-P-C
3-0-0-3

Course Outcomes: After the successful completion of the course the students will be able to:

1. Develop a digital logic and apply it to solve real life problems.
2. Analyze, design and implement combinational logic circuits.
3. Classify different semiconductor memories.
4. Analyze, design and implement sequential logic circuits.
5. Simulate and implement combinational and sequential circuits using VHDL systems.

Unit-1

Principles of combinational logic: Review of Boolean Algebra. Definition of combinational, Canonical forms, Generation of switching equations from truth tables, Karnaugh maps-3, 4 and 5 variables. Incompletely specified functions (Don't care terms). Simplifying max – term equations. Quine -McClusky minimization technique, Quine – McClusky using don't care terms, Reduced Prime Implicant tables, Map entered variables

Unit-2

Analysis and design of Combinational Logic: General approach, Decoders-BCD decoders, Encoders. Digital multiplexers-using multiplexers as Boolean function generators. Adders and Subtractors-Cascading full adders, Look ahead carry adder, Binary comparators.

Unit-3

Sequential Circuits: Basic Bi-stable element, Latches, SR latch, Application of SR latch, A Switch debouncer. The SR latch, The gated SR latch. The gated D Latch, The Master-Slave Flip-Flops (Pulse-Triggered Flip-Flops): The master-slave SR Flip-Flops, The master-slave JK Flip-Flop, Edge Triggered Flip-flop: The Positive Edge-Triggered D Flip-Flop, Negative-Edge Triggered D Flip-Flop. Characteristic equations, Registers, Counters-Binary Ripple Counter, Synchronous Binary counters, Counters based on Shift Registers, Design of a Synchronous counters, Design of a Synchronous Mod-N counters using clocked JK Flip-Flops Design of a Synchronous Mod-N counter using clocked D, T, or SR Flip-Flops

Unit-4

Sequential Design: Introduction, Mealy and Moore models, State machine notation, synchronous sequential circuit analysis and design. Construction of state Diagrams, Counters Design.

Unit-5

HDL: Introduction, A brief history of HDL, Structure of HDL Module, Operators, Data types, Types of Descriptions, Simulation and synthesis, Brief comparison of VHDL and Verilog. Data-Flow Descriptions: Highlights of Data flow descriptions, Structure of data-flow description, Data type-vectors.

Text/Reference Books:

10. Digital Logic Applications and Design John M Yarbrough Cengage Learning 2011
11. Digital Principles and Design Donald D Givone McGraw Hill Education 1 st Edition, 2002
12. Logic and computer design Fundamentals M. Morries Mano and Charles Kime Pearson Learning 4 th Edition, 2014
13. Circuit Design and Simulation with VHDL Volnei A Pedroni PHI 2nd Edition,
14. Fundamentals of logic design Charles H Roth, JR and Larry L. Kinney Cengage Learning 6th Edition, 2013
15. Fundamentals of Digital Circuits A. Anand Kumar PHI 3rd Edition, 2014
16. Digital Logic Design and VHDL A.A.PhadkeS.M.Deokar Wiley India 1st Edition, 2009
17. Digital Circuits and Design D.P.KothariJ.S.Dhillon Pearson First Print 2015
18. HDL Programming (VHDL and Verilog) Nazeih M. BotrosCengage Learning 1st Edition, 2011

OEC 704 Micro-Electro Mechanical Systems

L-T-P-C
3-0-0-3

Course Outcomes: After the successful completion of the course the students will be able to:

1. Gain knowledge of basic approaches for micro/Nano system design.
2. Understanding the concept of state-of-the-art lithography techniques for micro/Nano systems.
3. Aanalyze the Interfacing of Sensors, Actuators using appropriate DAQ micro-controller.
4. Learn new materials, science and technology for micro/Nano system applications.
5. Understand state-of-the-art micromachining and packaging technologies.

Unit-1

Introduction: Overview of MEMS and Microsystems: MEMS and Microsystem, Typical MEMS and Microsystems Products, Evolution of Micro-fabrication, Microsystems and Microelectronics, Multidisciplinary Nature of Microsystems, Miniaturization. Applications and Markets

Unit-2

Working Principles of Microsystems: Introduction, Microsensors, Microactuation, MEMS with Microactuators, Microaccelerometers, Microfluidics.

Unit-3

Material Processing: Silicon Wafer processing, Lithography, Thin-Film Deposition, Etching (Wet and Dry), Wafer Bonding and Metallization, Thick film processing, Smart Material processing, Emerging trends

Unit-4

Electronic circuit and Control: Carrier concentration, semiconductor diodes, transistor, MOSFET, Introduction to operational amplifier, Examples from Micro system, Transfer Function, state space modeling model order reduction, examples from smart systems

Unit-5

Micro-manufacturing, Integration and Packaging: Introduction, Bulk Micro-manufacturing, Surface Micromachining, The LIGA Process Integration and Packaging of Micro-electromechanical systems.

Text/Reference Books:

1. MEMS, NitaigourPremchandMahalik, TMH Publishing co.
2. Foundation of MEMS, Chang Liu, Prentice Hall Ltd.
3. MEMS and NEMS, Sergey EdwrdLyshevski, CRC Press, Indian Edition.
4. MEMS and Micro Systems: Design and Manufacture, Tai-Ran Hsu, TMH Publishers.
5. Introductory MEMS, Thomas M Adams, Richard A Layton, Springer International Publishers.

Non-Conventional Energy Resources (OEC 705)

L T P C

3 0 0 3

Prerequisite: Basic Knowledge of Power Plant Engineering.

Couse Outcomes (COs):

1. Illustrate the generation of electricity from various Non-Conventional sources of energy, have a working knowledge on types of fuel cells.
2. Study the solar energy, Utilization of it, Principles involved in solar energy collection and conversion of it to electricity generation.
3. Study the working principle of geothermal energy,Magneto-hydrodynamics (MHD) and fuel cell technology for energy generation.
4. Explore the concepts involved in wind energy conversion system by studying its components, types and performance.
5. Study the working principle of bio mass, wave and tidal wave and OTEC.

Course Contents:

Unit I

Introduction: Various non-conventional energy resources- Introduction, availability, classification, relative merits and demerits.

Solar Cells: Theory of solar cells. solar cell materials, solar cell array, solar cell power plant, limitations.

UNIT II

Solar Thermal Energy: Solar radiation, flat plate collectors and their materials, applications and performance, focusing of collectors and their materials, applications and performance; solar thermal power plants, thermal energy storage for solar heating and cooling, limitations.

UNIT III

Geothermal Energy: Resources of geothermal energy, thermodynamics of geo-thermal energy conversion-electrical conversion, non-electrical conversion, environmental considerations.

Magneto-hydrodynamics (MHD): Principle of working of MHD Power plant, performance and limitations.

Fuel Cells: Principle of working of various types of fuel cells and their working, performance and limitations.

UNIT IV

Thermo-electrical and thermionic Conversions: Principle of working, performance and limitations.

Wind Energy: Wind power and its sources, site selection, criterion, momentum theory, classification of rotors, concentrations and augments, wind characteristics. performance and limitations of energy conversion systems.

UNIT V

Bio-mass: Availability of bio-mass and its conversion theory.

Ocean Thermal Energy Conversion (OTEC): Availability, theory and working principle, performance and limitations.

Wave and Tidal Wave: Principle of working, performance and limitations. Waste Recycling Plants.

Text Books:

1. Raja etal, "Introduction to Non-Conventional Energy Resources" Scitech Publications.
2. D.S. Chauhan,"Non-conventional Energy Resources" New Age International.
3. C.S. Solanki, "Renewal Energy Technologies: A Practical Guide for Beginners" PHI Learning.

Reference Books:

1. John Twideu and Tony Weir, "Renewal Energy Resources" BSP Publications, 2006.
2. M.V.R. KoteswaraRao, "Energy Resources: Conventional & Non-Conventional " BSP Publications,2006.

Nanotechnology (OEC 706)

L T P C

3 0 0 3

Prerequisite: Basic Knowledge of Materials Science.

Course Outcomes (COs):

After completion of this course student will be able to:

1. Explain the fundamental principles of nanotechnology and their application to engineering.
2. Apply engineering and physics concepts to the Nano-scale and non-continuum domain.
3. Study the properties of individual Nano particles, metal Nano clusters and semi conducting nanomaterial.
4. Discuss and evaluate state-of-the-art characterization methods for nanomaterial, and determine nanomaterial safety and handling methods required during characterization.
5. Explain methods of fabricating nanostructures of carbon Buckey Ball, Carbon nano-tubes

Course Contents:

Unit I

Introduction: Definition of Nano-Science and Nano Technology, Applications of Nano-Technology.

Introduction to Physics of Solid State:Structure: Size dependence of properties; crystal structures, face centered cubic nanoparticles; Tetrehedrally bounded semiconductor structures; lattice vibrations.

Energy Bands: Insulators, semiconductor and conductors; Reciprocal space; Energy bands and gaps of semiconductors; effective masses; Fermi Surfaces.

Localized Particles: Acceptors and deep taps; mobility; Excitons.

Unit II

Quantum Theory For Nano Science: Time dependent and time independent Schrodinger wave equations. Particle in a box, Potential step: Reflection and tunneling (Quantum leak). Penetration of Barrier, Potential box(Trapped particle in 3D:Nanodot), Electron trapped in 2D plane(Nano sheet), Quantum confinement effect in nano-materials.

Quantum Wells, Wires and Dots: Preparation of Quantum Nanostructure; Size and Dimensionality effect, Fermigas; Potential wells; Partial confinement; Excitons; Single electron Tunneling, Infrared etectors; Quantum dot laser Superconductivity.

Properties of Individual Nano particles,Metal Nano clusters: Magic Numbers; Theoretical Modelling of Nanopraticles; geometric structure; electronic structure; Reactivity; Fluctuations Magnetic Clusters; Bulle to Nano structure.

Semi conducting Nanoparticles: Optical Properties; Photofragmentation; Coulmbic explosion.

Rare Gas & Molecular Clusters: Inert gas clusters; Superfluid clusters molecular clusters.

Unit III

Growth Techniques of Nanomaterials: Lithograpahic and Nonlithograpahic techniques, Sputtering and film deposition in glow discharge, DC sputtering technique (p-$CuAlO_2$ deposition). Thermal evaporation technique, E-beam evaporation, Chemical Vapour deposition(CVD), Synthesis of carbon nano-fibres and multi-walled carbon nanotubes, Pulsed Laser Deposition, Molecular beam Epitoxy, Sol-Gel Techniuqe (No chemistry required), Synthesis of nanowires/rods, Electrodeposition, Chemical bath deposition, Ion beam deposition system, Vapor-Liquid –Solid (VLS) method of nanowires. **8**

Unit IV

Methods of Measuring Properties:Structure: Crystallography, particle size determination, surface structure,

Microscopy: Scanning Prob Microscopy (SPM), Atomic Force Microscopy (AFM), Field Ion Microscopy, Scanning Electron Microscopy, Transmission Elecrtron Microscopy (TEM)

Spectroscopy: Infrared and Raman Spectroscopy, X-ray Spectroscopy, Magnetic resonance, Optical and Vibrational Spectroscopy, Luninscence.

Unit V

Buckey Ball: Nano structuresofcarbon(fullerene): **Carbon nano-tubes:** Fabrication , structure. electrical, mechanical, and vibrational properties and applications. Nano diamond, Boron Nitride Nano-tubes, single elecron transistors, Moelcular machine, Nano-Biometrics, Nano Robots.

Text Books:

1. A.K.Bandyopadhyay, “Nano Materials” New Age International.
2. “Introduction to S.S. Physics” - (7^{th} Edn.) Wiley 1996.

Reference Books:

1. C.P.PooleJr F.J. Owens, “Introduction to Nanotechnology”. (5).
2. S. Sugano & H. Koizuoni, “Microcluster Physics” –Springor 1998.
3. “Handboole of Nanostructured Materials & Nanotechnology” vol.-5. Academic Press 2000.

Non-Destructive Evaluation (OEC 707)

L T P C

3 0 0 3

Prerequisite: Basic Knowledge of Material Science and Engineering.

Course Outcomes (COs):

After completion of this course student will be able to:

1. Obtain the fundamental knowledge about different NDT methods and visual inspection.
2. Explain the principles and testing knowledge of DPT(liquid penetrate inspection) and MPT for product testing.
3. Explain the principles and techniques in Radiography Testing.
4. Describe the knowledge about Ultrasonic Testing for products.
5. Understand the materials and testing procedure for Eddy Current Inspection&Thermography Testing.

Course Contents:

Unit I

Introduction:Scope and advantages of NDT, Comparison of NDT with Destructive Testing, some commonNDT methods used since ages, Terminology, Flaws and Defects, Visual inspection, Equipmentused for visual inspection. Ringing test, chalk test (oil whitening test). Uses of visual inspectiontests in detecting surface defects and their interpretation, advantages &limitations of visual inspection.

Unit II

Tests: Die penetrate test (liquid penetrate inspection), Principle, scope. Equipment & techniques, Test stations, Advantages, types of penetrants and developers, Zyglo test, Illustrative examples andinterpretation of defects.Magnetic particle Inspection – scope and working principle, Ferro Magnetic and Nonferromagnetic materials, equipment & testing. Advantages, limitations Interpretation of results,DC& AC magnetization, Skin Effect, use of dye & wet powders for magna glow testing,different methods to generate magnetic fields, Applications.

Unit III

Radiographic methods: Introduction to electromagnetic waves and radioactivity, various decays, Attenuation ofelectromagnetic radiations, Photo electric effect, Rayleigh's scattering (coherent scattering),Compton's scattering (Incoherent scattering), Pair production, Beam geometry and

Scatteringfactor. X-ray radiography: principle, equipment & methodology, applications, types of radiations andlimitations. γ-ray radiography – principle, equipment., source of radioactive materials &technique, advantages of γ-ray radiography over X-ray radiography Precautions against radiationhazards. Case Study - casting and forging.

Unit IV

Ultrasonic testing methods: Introduction, Principle of operation, Piezoelectricity. Ultrasonic probes, CRO techniques,advantages, Limitation & typical applications. Applications in inspection of castings, forgings,Extruded steel parts, bars, pipes, rails and dimensions measurements. Case Study – Ultrasonography of human body.

Unit V

Special NDT Techniques: Eddy Current Inspection: Principle, Methods, Equipment for ECT, Techniques, Sensitivity,advanced ECT methods. Application, scope and limitations, types of Probes and Case Studies.Introduction to Holography, Thermography and Acoustic emission Testing.

Text Books:

1. Non-Destructive Testing and Evaluation of Materials, by- Prasad, McGraw Hill Education
2. Practical Non-destructive Testing, by- Baldev Raj, T. Jayakumar, M. Thavasimuthu, WoodheadPublishing.
3. Non-Destructive Testing Techniques, by- Ravi Prakash, New Age International.

Reference Books

1. Nondestructive Testing Handbook,by Robert C. McMaster, American Society for Nondestructive.
2. Introduction to Nondestructive Testing: A Training Guide, by- Paul E. Mix, wiley.
3. Electrical and Magnetic Methods of Non-destructive Testing, by- J. Blitz, springer.
4. Practical non destructive testing by Raj, Baldev.
5. Basics of Non-Destructive Testing, by Lari& Kumar, KATSON Books.

Introduction to Mechanical Micro Machining (OEC 708)

L T P C

3 0 0 3

Prerequisite: Basic Knowledge of Conventional machining processes..

Course Outcomes (COs):

1. Understand of process of Ultra Sonic Micro Machining, Abrasive Jet Micro Machining, Water Jet Micro Machining etc.
2. Explain the Beam Energy based micro machining, Electron Beam Micro Machining, Laser Beam Micro Machining, Electric Discharge Micro Machining etc.
3. To understand the Magneto Rheological abrasive flow finishing, Magnetic Float polishing, Elastic Emission Machining etc.
4. Understand of Micro bending with LASER, LASER micro welding, Electron beam for micro welding.
5. Understand the Metrology for micro machined components and Machining of Micro gear, micro nozzle, micro pins, Applications.

Course Contents:

UNIT I

MICRO MACHINING: Ultra Sonic Micro Machining, Abrasive Jet Micro Machining, Water Jet Micro Machining, Abrasive Water Jet Micro Machining, Micro turning, Chemical and Electro Chemical Micro Machining, Electric discharge micro machining.

UNIT II

MICRO MACHINING: Beam Energy based micro machining, Electron Beam Micro Machining, Laser Beam Micro Machining, Electric Discharge Micro Machining, Ion Beam Micro Machining, Plasma Beam Micro Machining, Hybrid Micro machining, Electro Discharge Grinding, Electro Chemical spark micro machining, Electrolytic in process Dressing.

UNIT III

NANO POLISHING: Abrasive Flow finishing, Magnetic Abrasive Finishing, Magneto rheological finishing, Magneto Rheological abrasive flow finishing, Magnetic Float polishing, Elastic Emission Machining, chemo-mechanical Polishing.

UNIT IV

MICRO FORMING AND WELDING: Micro extrusion, Micro and Nano structured surface development by Nano plastic forming and Roller Imprinting, Micro bending with LASER, LASER micro welding, Electron beam for micro welding.

UNIT V

RECENT TRENDS AND APPLICATIONS: Metrology for micro machined components, Ductile regime machining, AE based tool wear compensation, Machining of Micro gear, micro nozzle, micro pins, Applications.

Text Books:

1. Jain V. K., Micro Manufacturing Processes, CRC Press, Taylor & Francis Group, 2012.
2. Jain V.K., _Introduction to Micro machining‘ Narosa Publishing House, 2011
3. Jain V.K., Advanced Machining Processes, Allied Publishers, Delhi, 2002.

Reference Books:

1. Janocha H., Actuators – Basics and applications, Springer publishers – 2012
2. Bharat Bhushan, Handbook of nanotechnology, springer, Germany, 2010.
3. Bandyopadhyay. A.K., Nano Materials, New age international publishers, New Delhi, 2008, ISBN:8122422578.
4. Mcgeoug.J.A., Micromachining of Engineering Materials, CRC press 2001, ISBN-10:0824706447.

Data science (OEC 709)

L T P C

3 0 0 3

Course Outcomes

CO1.Describe what Data Science is and the skill sets needed to be a data scientist. • Explain in basic terms what Statistical Inference means. Identify probability distributions commonly used as foundations for statistical modeling. Fit a model to data.

CO2. Use R to carry out basic statistical modeling and analysis.

CO3. Explain the significance of exploratory data analysis (EDA) in data science. Apply basic tools (plots, graphs, summary statistics) to carry out EDA.

CO4. Describe the Data Science Process and how its components interact

CO5 Use APIs and other tools to scrap the Web and collect data. And Apply EDA and the Data Science process in a case study.

Unit 1. Introduction: What is Data Science? - Big Data and Data Science hype – and getting past the hype - Why now? – Datafication - Current landscape of perspectives - Skill sets needed . Statistical Inference - Populations and samples - Statistical modeling, probability distributions, fitting a model - Intro to R

Unit 2. Exploratory Data Analysis and the Data Science Process - Basic tools (plots, graphs and summary statistics) of EDA - Philosophy of EDA - The Data Science Process - Case Study: RealDirect (online real estate firm) Three Basic Machine Learning Algorithms - Linear Regression - k-Nearest Neighbors (k-NN) - k-means

Unit 5. One More Machine Learning Algorithm and Usage in Applications - Motivating application: Filtering Spam - Why Linear Regression and k-NN are poor choices for Filtering Spam - Naive Bayes and why it works for Filtering Spam - Data Wrangling: APIs and other tools for scrapping the Web Feature Generation and Feature Selection (Extracting Meaning From Data) - Motivating application: user (customer) retention - Feature Generation (brainstorming, role of domain expertise, and place for imagination) - Feature Selection algorithms – Filters; Wrappers; Decision Trees; Random Forests

Unit 4 Recommendation Systems: Building a User-Facing Data Product - Algorithmic ingredients of a Recommendation Engine - Dimensionality Reduction - Singular Value Decomposition - Principal Component Analysis - Exercise: build your own recommendation system 8. Mining Social-Network Graphs - Social networks as graphs - Clustering of graphs - Direct discovery of communities in graphs - Partitioning of graphs - Neighborhood properties in graphs

Unit 5. Data Visualization - Basic principles, ideas and tools for data visualization 3 - Examples of inspiring (industry) projects - Exercise: create your own visualization of a complex dataset 10. Data Science and Ethical Issues - Discussions on privacy, security, ethics - A look back at Data Science - Next-generation data scientists

References

Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk From The Frontline. O'Reilly. 2014.

• Jure Leskovek, AnandRajaraman and Jeffrey Ullman. Mining of Massive Datasets. v2.1, Cambridge University Press. 2014. (free online)

• Kevin P. Murphy. Machine Learning: A Probabilistic Perspective. ISBN 0262018020. 2013.

• Foster Provost and Tom Fawcett. Data Science for Business: What You Need to Know about Data Mining and Data-analytic Thinking. ISBN 1449361323. 2013.

• Trevor Hastie, Robert Tibshirani and Jerome Friedman. Elements of Statistical Learning, Second Edition. ISBN 0387952845. 2009. (free online)

• Avrim Blum, John Hopcroft and Ravindran Kannan. Foundations of Data Science

• Mohammed J. Zaki and Wagner Miera Jr. Data Mining and Analysis: Fundamental Concepts and Algorithms. Cambridge University Press. 2014.

• Jiawei Han, MichelineKamber and Jian Pei. Data Mining: Concepts and Techniques, Third Edition. ISBN 0123814790. 2011.

BIG DATA ANALYTICS (OEC 710)

L T P C

3 0 0 3

COURSE OUTCOMES:

CO1:- To know the fundamental concepts of big data and analytics.

CO2:- To understand the different way to classify the given data using different techniques.

CO3:- To explore tools and practices for working with big data

CO4:- To learn about stream computing.

CO5:- To know about the research that requires the integration of large amounts of data.

UNITI

INTRODUCTION TO BIGDATA

Evolution of Big data - Best Practices for Big data Analytics - Big data characteristics - Validating - The Promotion of the Value of Big Data - Big Data Use Cases- Characteristics of Big Data Applications - Perception and Quantification of Value -Understanding Big Data Storage - A General Overview of High- Performance Architecture - HDFS - MapReduce and YARN - Map Reduce Programming Model

UNITIII

ASSOCIATION AND RECOMMENDATIONSYSTEM

Advanced Analytical Theory and Methods: Association Rules - Overview - Apriori Algorithm - Evaluation ofCandidateRules - Applications of Association Rules - Finding Association& finding similarity.

Recommendation System: Collaborative Recommendation- Content Based Recommendation - Knowledge Based Recommendation- Hybrid RecommendationApproaches.

UNIT IV

STREAMMEMORY

Introduction to Streams Concepts – Stream Data Model and Architecture - Stream Computing, Sampling Data in a Stream – Filtering Streams – Counting Distinct Elements in a Stream – Estimating moments – Counting oneness in a Window – Decaying Window – Real time Analytics Platform(RTAP) applications -

Case Studies - Real Time Sentiment Analysis, Stock Market Predictions. Using Graph Analytics for Big Data: GraphAnalytics

UNIT V

NOSQL DATA MANAGEMENT FOR BIG DATAAND VISUALIZATION

NoSQL Databases : Schema-less Models‖: Increasing Flexibility for Data Manipulation-Key Value Stores- Document Stores - Tabular Stores - Object Data Stores - Graph Databases Hive - Sharding –- Hbase – Analyzing big data with twitter - Big data for E-Commerce Big data for blogs - Review of Basic Data Analytic Methods using R.

TEXT BOOKS:

1. AnandRajaraman and Jeffrey David Ullman, "Mining of Massive Datasets", Cambridge University Press, 2012.

2. David Loshin, "Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph", Morgan Kaufmann/El sevier Publishers, 2013.

OEC-711	Machine learning and Python Programming	L-T-P-C: 3-0-0-3
Course Outcomes: At the end of this course students will demonstrate the ability to		
CO1	Do progamming with Python	
CO2	Apply Statistics to machine learning and know how it is different than descriptive statistics	
CO3	Build features that meet analysis needs and understand different approaches for creating predictive models	
CO4	Create and evaluate data clusters	
CO5	Apply Python for NLP	

UNIT I Python Fundamentals

The basic foundation of variables– Data types – Arithmetic, logical and comparison operator – Data types of Python List – Data Cleansing – Dictionary– Conditional and Iterative loops - Numpy Library - Data Manipulation using Pandas Library - Data Visualization - visualizations using Matplotlib and Seaborn Python libraries – Merging multiple datasets - Melting/changing dimensions of datasets

UNIT II Fundamentals of Statistics

Graphically Displaying Single Variable -Measures of Location - Measures of Spread - Displaying relationship – Bivariate Data – Scatterplot - Measures of association of two or more variables - Covariance and Correlation - Probability - Joint Probability and independent events - Conditional probability - Bayes' Theorem - Prior, Likelihood and Posterior - Discrete Random Variable - Probability Distribution of Discrete Random Variable - Binomial Distribution - Continuous Random Variables - Probability Distribution Function - Uniform Distribution - Normal Distribution - Point Estimation – Interval Estimation - Hypothesis Testing

UNIT III Machine learning with Python

Supervised and Unsupervised Learning - Python libraries suitable for Machine Learning
Regression – Features and Labels– Training and Testing– Forecasting and Predicting– Theory and how it works– to program Best Fit Slope – to program the Best Fit Line– R Squared and Coefficient of Determination Theory - Model evaluation methods
Classification: Applying K Nearest Neighbors to Data -Euclidean Distance theory -Decision Trees - Regression Trees - Random Forests - Boosting Algorithm - Principal Component Analysis - Linear Discriminant Analysis
Support Vector Machine Fundamentals - Constraint Optimization with Support Vector Machine - SVM Optimization in Python - Visualization and Predicting with our Custom SVM - Kernels - Soft Margin Support Vector Machine

UNIT IV Clustering

Handling Non-Numerical Data for Machine Learning - K-Means with Titanic Dataset - K-Means in Python - Hierarchical Clustering with Mean Shift Introduction - Naive Bayes Classifier - Naive Bayes Classifier with Scikit - Introduction into Text Classification using Naive Bayes - Python Implementation of Text Classification

UNIT V Introduction to NLP

Text Pre-processing, Noise Removal, Lexicon Normalization, Lemmatization, Stemming, Object Standardization- Text to Features (Feature Engineering on text data)-Syntactical Parsing, Dependency Grammar- Part of Speech Tagging - Entity Parsing- Phrase Detection - Named Entity Recognition - Topic Modelling - N-Grams - Statistical features - TF – IDF- Frequency / Density Features: Readability Features, Word Embedding
Important tasks of NLP: Text Classification, Text Matching, Levenshtein Distance, Phonetic Matching, Flexible String Matching - Important NLP libraries

Reference Books:

1. Introduction-to-Machine-Learning-with-Python, Andreas C. Muller and Sarah Guido, O'Reilly Books
2. Beginning Programming with Python For Dummies, John Paul Mueller

OEC-712	Embedded Systems	L-T-P-C: 3-0-0-3
Course Outcomes: At the end of this course students will demonstrate the ability to		
CO1	Choose between design approaches using advanced controllers to real-life situations	
CO2	Design interfacing of the systems with other data handling / processing systems	
CO3	Appreciate engineering constraints like energy dissipation, data exchange speeds etc	
CO4	Understand software aspects of Embedded Systems	

UNIT I

The concept of embedded systems design, Embedded microcontroller cores, embedded memories. Examples of embedded systems.

UNIT II

Technological aspects of embedded systems: interfacing between analog and digital blocks, signal conditioning, digital signal processing.

UNIT III

Sub-system interfacing, interfacing with external systems, user interfacing

Design tradeoffs due to process compatibility, thermal considerations, etc.,

UNIT IV

Software aspects of embedded systems: real time programming languages and operating systems for embedded systems.

Text/Reference Books:

1. J.W. Valvano, "Embedded Microcomputer System: Real Time Interfacing", Brooks/Cole, 2000.

2. Jack Ganssle, "The Art of Designing Embedded Systems", Newness, 1999.

3. V.K. Madisetti, "VLSI Digital Signal Processing", IEEE Press (NY, USA), 1995.

4. David Simon, "An Embedded Software Primer", Addison Wesley, 2000.

5. K.J. Ayala, "The 8051 Microcontroller: Architecture, Programming, and Applications", Penram Intl, 1996.

OPEN ELECTIVE –IV

OEC	REMOTE SENSING AND GIS APPLICATION	OEC 801	4 0 0	4 CREDITS
COURSE OUTCOMES:				
CO1	Retrieve the information content of remotely sensed data			
CO2	Understand characteristics of multi concept of remote sensing.			
CO3	Interpret the images for preparation of thematic maps.			
CO4	Understand the concept & terminology of GIS.			
CO5	Apply the RS & GIS in real world problems.			

Unit I

Remote Sensing: Introduction, sources of energy for remote sensing, active and passive sources, electromagnetic radiation, and their characteristics, thermal emission, Interaction of EMR with atmosphere, atmospheric windows, interaction of EMR with earth surface- spectral reflection curves.

Unit II

Multi concept of remote sensing, idealisms and real sequence of remote sensing, sensors and orbital characteristics, various sensing platforms for remote sensing, characteristics of various satellite, remote sensing data products and their uses.

Unit III

Digital image processing: Introduction, digital image representation, and Characterization, histograms and scatter plot, image enhancement, contrast stretching, Pattern recognition, and feature extraction, image classification: unsupervised and Supervised techniques

Unit IV

Geographic Information system: Introduction, concept and terminology, components of GIS, raster and Vector formats, scanners and digitizers, methods of digitization, data Preprocessing, form conversion, data reduction, and generalization

Unit V

Data merging, edge matching, registration and re-sampling, data manipulation and Analysis representation of real-world problems, problem solving and spatial modeling, classification, aggregation, overlay, buffers and

indivisibility and its applications in planning of utility lines, flood studies, ground water recharge, erosion modeling,

References:

1. Remote Sensing and Image Interpretation – Lillesand and Kiefer, John Wiley &Sons Ltd.
2. Introduction to the physics and techniques of Remote Sensing – Elachi, John Wiley& SonsLtd.
3. Geographical Information System Vol. I and II– Longley, John Wiley & SonsLtd.
4. An Introduction to GIS – Ian Haywood, Dorlling Kindersley Pvt.Ltd.
5. Advanced Surveying by Satheesh, G., Sathikumar, R., and Madhu, N., Pearsons Educations

OEC	INFRASTRUCTURE ENGINEERING	OEC802	4 0 0	4 CREDITS

COURSE OUTCOMES:	
CO1	Identify the elements of Building.
CO2	Identify waste water & water supply sources.
CO3	Understand about transportation infrastructure(Road, rail and air).
CO4	Analysis the various characteristics of Dam, Canal, Port, Hourber and Hydroelectric projects.
CO5	Introduction to architecture, land use planning.

Unit I

Building-

Elements- slab, beam, column, footing Types- Residential, Institutional, Commercial, Industrial Types of structure- Load bearing, framed, combined

Unit II

Water Supply and Wastewater Infrastructure

Water Supply- Source, demand, intake, transport, conduits, treatment, distribution, household plumbing

Waste Water- Collection, transport, treatment and disposal

Unit III

Transport Infrastructure: Road, rail and air

Road- Elements, types, traffic studies Rail- Gauge, components Air- Runway, planning, helipad

Unit IV

Irrigation, hydropower and navigation

Dam, canal, port, harbor, hydroelectric projects

Unit V

Miscellaneous

Introduction to architecture, land use planning

References:

1. Peurify,RL,–Construction,Planning,EquipmentandMethods‖,TataMcGrawHillEducation
2. NPTEL E Learning course on Infrastructure Planning&Mangament.

OEC 803 Advance Sensors and Transducers

L-T-P-C
4-0-0-4

Course Outcomes: At the end of the course, students will demonstrate the ability to:

1. Apply the mathematical knowledge and science & engineering fundamentals gained to solve problems pertaining to measurement applications.
2. Analyze the problems related to sensors & transducers.
3. Select the appropriate sensor/transducer for a given application.
4. Determine the static and dynamic characteristics of transducers using software packages.
5. Understand fiber optic sensor and applications. Ability to understand smart traducer and its standard.

Unit-1 (8 Hrs)

Science of measurements and classification of transducers: Units and standards, Static calibration, Classification of errors, Limiting error and probable error, Error analysis, Statistical methods , Odds and uncertainty, Classification of transducers, Selection of transducers.

Unit-2 (8 Hrs)

Characteristics of transducers: Static characteristics, Accuracy, precision, resolution, sensitivity, linearity, span and range. Dynamic characteristics, Mathematical model of transducer, Zero, I and II order transducers.

Unit-3 (8 Hrs)

Variable resistance transducers: Principle of operation, construction details, characteristics and applications of potentiometer, strain gauge, resistance thermometer, Thermistor, hot-wire anemometer, piezo-resistive sensor and humidity sensor.

Unit-4 (8 Hrs)

Variable inductance and variable capacitance transducers: Inductive transducers, Principle of operation, construction details, characteristics and applications of LVDT, capacitive transducers, characteristics of capacitive transducers, Different types, Signal Conditioning, Applications, Capacitor microphone, Capacitive pressure sensor, Proximity sensor.

Unit-5 (8 Hrs)

Other transducers: Piezoelectric transducer, Hall Effect transducer, Magneto elastic sensor, Digital transducers, Fiber optic sensors, Thick & Thin Film sensors (Bio sensor & Chemical Sensor), Environmental Monitoring sensors (Water Quality & Air pollution), Introduction to Smart transducers and its applications.

Text/ Reference Books:

1. D. Patranabis, Sensors and Transducers, Prentice Hall of India.
2. Ian Sinclair, Sensors and Transducers, Elsevier.
3. Murthy, D.V.S., Transducers and Instrumentation, Prentice Hall of India.

OEC 804 Multimedia Communication

L-T-P-C
4-0-0-4

Course Outcomes: After completing this course the students will have the ability to:

1. Understand different types of media for information representation and Communication; representation of multimedia information in applications.
2. Interpret and process multimedia information as per requirement for society considering ethical issues.
3. Analyze and represent sound, speech, images, videos and also to store and communicate these efficiently.
4. Processing and transforming multimedia information as per requirement. Understanding and using standards for multimedia information.

Unit-1 (18 Hrs)
Multi-Dimensional Signals: Multi Dimensional signals-Finite Extent Signals and Periodic signals, Symmetric signals, special multi dimensional signals; Multi Dimensional Transforms-Fourier Transform, DFT, DCT;

Unit-2 (6 Hrs)
Multi Dimensional systems:-Impulse response and 2D convolution, Frequency response, FIR Filters and symmetry, IIR filters and partial difference equations, 2D sampling and reconstruction, Image digitization, Digital Image representation and storage, Pixels and its neighbors.

Unit-3 (9 Hrs)
Human Visual System and Color: Color Vision and Models, Contrast Sensitivity, Spatio-Temporal Frequency Response, Stereo/Depth Perception, Analog Video, Progressive vs. Interlaced Scanning, Analog-Video Signal Formats, Analog-to-Digital Conversion, Digital Video, Spatial Resolution and Frame Rate, Color, Dynamic Range, and Bit-Depth, Color Image Processing, Digital-Video Standards.

Unit-4 (10 Hrs)
Image Filtering: Image Smoothing, Linear Shift-Invariant Low-Pass Filtering; Image Enhancement, Pixel-Based Contrast Enhancement, Spatial Filtering for Tone Mapping and Image Sharpening, Image Denoising, Image and Noise Models, Linear Space-Invariant Filters in the DFT Domain, Local Adaptive Filtering, Nonlinear Filtering: Order-Statistics.

Unit-5 (9 Hrs)
Video Filtering: Theory of Spatio-Temporal Filtering, Frequency Spectrum of Video, Motion-Adaptive Filtering, Motion-Compensated Filtering, Video-Format Conversion, Down-Conversion, De-Interlacing, Frame-Rate Conversion, Multi-Frame Noise Filtering, Motion-Adaptive Noise Filtering, Motion-Compensated Noise Filtering.

Text/Reference Books:

1. R.C. Gonzalez and R.E. Woods, Digital Image Processing, 3rd Edition, Pearson Education, 2016.
2. Anil Kumar Jain, Fundamentals of Digital Image Processing, Pearson Education, 2015.

Power Plant Engineering (OEC 805)

L T P C

4 0 0 4

Prerequisite: Basic Knowledge of Thermodynamics and I C Engines.

Course outcomes (COs):

1. Understand the basics of power plants.
2. Analyze the working and layout of the of steam power plant.
3. Define the working principles of Diesel power plant, its layout, safety principles and compare it with other types of plants.
4. Discuss the working principle and basic components of the nuclear power plants and Hydro-electric power plants and safety precautions involved with it.
5. Discuss and analyze the mathematical and working principle of different electrical equipment involved in the generation of the power.

Course Contents:

Unit I

Introduction: Power and energy, sources of energy, review of thermodynamic cycles related to power plants, fuels and combustion calculations. Load estimation, load curves, various terms and factors involved in power plant calculations. Effect of variable load on power plant operation, Selection of power plant units.Power plant economics and selection.Effect of plant type on costs, rates, fixed elements, energy elements, customer elements and investor's profit; depreciation and replacement, theory of rates.Economics of plant selection, other considerations in plant selection.

Unit II

Steam power plant: General layout of steam power plant, Power plant boilers including critical and super critical boilers. Fluidized bed boilers, boilers mountings and accessories, Different systems such as coal handling system, pulverizes and coal burners, combustion system, draft, ash handling system, Dust collection system, Feed water treatment and condenser and cooling towers and cooling ponds, Turbine auxiliary systems such as governing, feed heating, reheating, flange heating and gland leakage. Operation and maintenance of steam power plant, heat balance and efficiency, Site selection of a steam power plant.

Unit III

Diesel power plant: General layout, Components of Diesel power plant, Performance of diesel power plant, fuel system, lubrication system, air intake and admission system, supercharging system, exhaust system, diesel plant operation and efficiency, heat balance, Site selection of diesel power plant, Comparative study of diesel power plant with steam power plant. Gas turbine power plant: Layout of gas turbine power plant, Elements of gas turbine power plants, Gas turbine fuels, cogeneration, auxiliary systems such as fuel, controls and lubrication, operation and maintenance, Combined cycle power plants, Site selection of gas turbine power plant, Integrated Gasifier based Combined Cycle (IGCC) systems.

Unit IV

Nuclear power plant: Layout and subsystems of nuclear power plants, Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANDU Reactor, Pressurized Heavy Water Reactor (PHWR), Fast Breeder Reactors (FBR), gas cooled and liquid metal cooled reactors, safety measures for nuclear power plants. Hydroelectric and Non-Conventional Power Plant: Hydroelectric power plants, classification, typical layout and components, principles of wind, tidal, solar PV and solar thermal, geothermal, biogas and fuel cell power systems.

Unit V

Electrical system: Generators and generator cooling, transformers and their cooling, bus bar, etc. Energy Saving and Control: Energy, economic and environmental issues, power tariffs, load distribution parameters, load curve, capital and operating cost of different power plants, pollution control technologies including waste disposal options for coal and nuclear plants.

Text Books:

1. Power Plant Engineering by P.K. Nag, Tata McGraw Hill.
2. Steam & Gas Turbines & Power Plant Engineering by R. Yadav, Central Pub. House.
3. Power Plant Engineering by Gupta, PHI India.

Reference Books:

1. Power Plant Engineering, by F.T. Morse, Affiliated East-West Press Pvt. Ltd.
2. Power Plant Engineering by Hedge, Pearson India.
3. Power Plant Technology, by Wakil, McGraw Hill.
4. Power Plant Engineering. Mahesh Verma, Metropolitan Book Company Pvt. Ltd.

Optimization Method in Engineering (OEC 806)

L T P C

4 0 0 4

Prerequisite: Course on calculus, matrix

Course Outcomes (COs):

After completion of the course a student will be able:

1. Learn one dimensional optimization methods.
2. Learn constrained optimization of multi-variable function.
3. Apply integer programming methods.
4. Dynamic programming and operation research problems
5. Learn soft computing based optimization.

Course Contents:

Unit I

Unconstrained Optimization: Optimizing Single-Variable Functions, Conditions for Local Minimum and Maximum, Optimizing Multi-Variable Functions.

Unit II

Constrained Optimization: Optimizing Multivariable Functions with Equality Constraint: Direct Search Method, Lagrange Multipliers Method, Constrained Multivariable Optimization with inequality constrained: Kuhn-Tucker Necessary conditions, Kuhn –Tucker Sufficient Conditions.

Unit III

Optimization: Quasi-Newton Methods and line search, least squares optimization, Gauss Newton, Extensions of LP to Mixed Integer Linear Programming (MILP), Non-Linar Programming, The Newton Algorithm, Non-Linear Least Squares, Sequential Quadratic Programming (SQP), Constrained Optimization, Multi-Objective Optimization, Branch and Bound Approaches.

Unit IV

Optimization in Operation Research: Dynamic Programming, Minimax and Maximax Algorithm, Discrete Simulation, Integer Programming – Cutting Plane Methods, Separable Programming, Goal Programming, Integer Linear Programming.

Unit V

Soft computing based optimization, Practical aspects of optimization.

Text books:

1. Engineering Optimization Theory and Practice by Rao S.S.
2. Methods of Optimization by Walsh G R.
3. Integer and Combinational Optimization by G.L.Nemhauser and L.A.Wolsey.
4. Operations Research: Applications and Algorithms by Winston W L

Reference books:

1. Model Building in Mathematics Programming by Williams H.P.
2. Integer and Combinational Optimization by G.L.Nemhauser and L.A.Wolsey
3. Discrete Optimization by R.G. Parker and R.L. Rardin.
4. Combinational Optimization: Algorithms and Complexity by C.H. Papadimitrious and K.Stegilite
5. Multi-objective evolutionary optimization for Product Design and Manufacturing by LihuiWang
6. Genetic Algorithms by Kalyanmoy Deb
7. Genetic Algorithms in search, optimization and machine learning by David E Goldberg, Pearson Springer.

Fracture Mechanics (OEC 807)

L T P C

4 0 0 4

Prerequisite: Basic Knowledge of Mechanics of Solids and Theory of Elasticity.

Course Outcomes (COs):

1. Basic Understanding of Crack in a Structure, Fracture Toughness, Types of Fracture.
2. Analyze elastic and elastic-plastic stress fields at the crack-tip in a solid material..
3. Estimate crack growth based on energy balance.
4. Demonstrate standard fracture mechanics tests for finding J-Integral and Crack Opening Displacement.
5. Inspect a solid material for the presence of crack.

Course Contents:

Unit I

Introduction: A Crack in a Structure, Fracture Toughness. Micro and Macro Phenomena of Fracture - Microscopic Aspects: Surface Energy, Theoretical Strength, Microstructure and Defects, Crack Formation - Macroscopic Aspects: Crack Growth, Types of Fracture, Mechanisms of Fracture and Crack Growth - Cleavage Fracture, Ductile Fracture, Fatigue Cracking, Environment Assisted Cracking, Creep Fracture, Service Failure Analysis

Unit II

Linear Elastic Stress Fields in Cracked Bodies • Introduction • Crack Deformation Modes and Basic Concepts, Westergaard Method, Singular Stress and Displacement Fields,Stress Intensity Factor Solutions,Three-Dimensional Cracks

Linear Elastic-Plastic Stress Fields in Cracked Bodies: Approximate Determination of the Crack-Tip Plastic Zone, Irwin's Model, Dugdale's Model

Unit III

Crack Growth Based on Energy Balance: Introduction, Energy Balance During Crack Growth, Griffith Theory, Graphical Representation of the Energy Balance Equation, Equivalence between Strain Energy Release Rate and Stress Intensity Factor, Compliance, Crack Stability.

Unit IV

Fracture Criteria: Critical Stress Intensity Factor Fracture Criterion, J-Integral and Crack Opening Displacement Fracture Criteria, Strain Energy Density Failure Criterion: Mixed-Mode Crack Growth.

Dynamic Fracture Introduction, Mott's Model , Stress Field around a Rapidly Propagating Crack , Strain Energy Release Rate, Crack Branching, Crack Arrest ,Experimental Determination of Crack Velocity and Dynamic Stress Intensity

Unit V

Introduction to Fatigue Fracture, Environment-Assisted Fracture, Creep Fracture and Crack Detection Methods such as Dye Penetration, Magnetic Particles, Eddy Current, Radiography, Ultrasonic, and Acoustic Emission**.**

Text Books:

1. Prashant Kumar, "Elements of Fracture Mechanics", Tata McGraw Hill Education Pvt. Ltd.
2. T.L. Anderson, "Fracture Mechanics - Fundamentals and Applications", CRC - Taylor and Francis.

Reference Books:

1. E.E. Gdoutos, "Fracture Mechanics - An Introduction", Springer.
2. D. Broek, "Elementary Engineering Fracture Mechanics", Kluwer Academic Publishers.
3. R.W. Hertzberg, "Deformation and Fracture Mechanics of Engineering Materials", Wiley India Pvt. Ltd.

Machine Tool Design (OEC 808)

L T P C

4 0 0 4

Prerequisite: Basic Knowledge of Workshop Technology.

Course Outcomes (COs):

After successful completion of this course students will be able to

1. Understand classification of machine tools with their nomenclature, specification and uses.
2. Explain working of various drives mounted in machine tools.
3. Analyze the speed and feed box with the regulation of speed and feed rates.
4. Design components like structural bed, column, power screws etc.
5. Apply knowledge to study dynamics of machine tool and its control.

Course Contents:

UNIT I

Introduction: Developments is machine tools, types of machine tools surface, profits and paths produced by machine tools. Features of construction and operations of basic machine tools e.g. lathe, drill, milling shapes and planers, grinding machine etc.General requirement of machine tool design.Machine tool design process. Tool wear, force Analysis.

UNIT II

Machine Tools Drives: Classification of machine tool drives, group Vs individual drives, Selection of electric motor, A brief review of the elements of mechanical transmission e.g. gear, belt and chain drives, Slider-crank mechanism, cam mechanism, nut & Screw transmission, Devices for intermittent motion, reversing & differential mechanisms. Couplings and clutches Elements of hydraulic transmission system. e.g. pumps, cylinder, directional control valves, pressure valves etc., Fundamentals of Kinematics structure of machine tools.

UNIT III

Regulation of Speed and Feed rates: Laws of stepped regulation, selection of range ratio, standardprogression ratio, selection of best possible structural diagram, speed chart, Design of feed box,developing gearing diagrams. stepless regulation of speed and feed in machine tool, speed and feedcontrol.

UNIT IV

Design of Machine Tool Structure: Requirements and design criteria for machine tool structures,selection of material Basic design procedure for machine tool structures, design of bed, column andhousing, Model technique in design.

Design of guide ways and power screws: Basic guide way profiles, designing guide way for stiffness a wear resistance, hydrostatic and antifriction grand ways. Design of sliding friction power Screws. Design of spindlier & spindle supports. Layout of bearings, selection of bearings for machine tools.

UNIT V

Dynamics of machine tools: General procedure for assessing the dynamic stability of cutting process,closed loop system, chatter in machine tools.

Control Systems: Functions, requirements & types of machine tool controls, controls for speed &feed change. Automatic and manual Controls.Basics of numerical controls.Machine tool testing.

Text Books:

1. N.K. Mehta, "Machine Tool Design and Numerical Control" Second Edition, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1984.
2. S.K. Basu and D.K. Pal, "Design of Machine Tools", Fourth Edition, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 1990.
3. G.C. Sen and A. Bhattacharya, "Principles of Machine Tools", Second Edition, New Central Book Agency (P) Ltd., Kolkata, 1988.

Reference Books:

1. F. Koenigsberger, "Design Principles of Metal Cutting and Machine Tools", Edition 1964, Pergamon Press Ltd., London.
2. H.C.Town, "The Design and Construction of Machine Tools", Central Machine Tool Research Institute, Bangalore, Machine Tool Design Handbook.
3. PSG College of Engg. & Technology, PSG Design Data Book.
4. N.K. Acherkan, "Machine Tool Design (Vol.I to Vol.IV)", Mir Publishers.

OEC809	BLOCKCHAIN	4L-0T-0P	CREDIT -4

Course outcome expected:

By the end of the course the students should be able to:

CO1: To explore of blockchain and its architecture.
CO2: Understand the consensus, Consensus protocols for Permissioned Blockchains.
CO3: understand theHyperledger Fabric and its implementation.
CO4: Applies blockchain concept in Financial Software and Systems, trade/supply chain (use cases).
CO5: Applies blockchain concept for Government(use case).

Unit-I Introduction :

Introduction to Blockchain: Digital Money to Distributed Ledgers , Design Primitives: Protocols, Security, Consensus, Permissions, Privacy. Blockchain Architecture and Design: Basic crypto primitives: Hash, Signature,) Hashchain to Blockchain, Basic consensus mechanisms

Unit-II : Consensus: Requirements for the consensus protocols, Proof of Work (PoW), Scalability aspects of Blockchain consensus protocols Permissioned Blockchains:Design goals, Consensus protocols for Permissioned Blockchains

Unit-III : Hyperledger Fabric (A): Decomposing the consensus process , Hyperledger fabric components, Chaincode Design and Implementation Hyperledger Fabric (B): Beyond Chaincode: fabric SDK and Front End (b) Hyperledger composer tool

Unit-IV:Use case 1 : Blockchain in Financial Software and Systems (FSS): (i) Settlements, (ii) KYC, (iii) Capital markets, (iv) Insurance Use case 2: Blockchain in trade/supply chain: (i) P Provenance of goods, visibility, trade/supply chain finance, invoice management discounting, etc

Unit-V Use case 3: Blockchain for Government: (i) Digital identity, land records and other kinds of record keeping between government entities, (ii) public distribution system social

Text Books:

1. MsteringBitcoin: Unlocking Digital Cryptocurrencies, by Andreas Antonopoulos
2. Blockchain by Melanie Swa, O'Reilly
3. Hyperledger Fabric - https://www.hyperledger.org/projects/fabric
4. Zero to Blockchain - An IBM Redbooks course, by Bob Dill, David Smits - https://www.redbooks.ibm.com/Redbooks.nsf/RedbookAbstracts/crse0401.html

OEC 810	Computer Vision	4L-0T-0P	CREDIT -4

Course outcome expected:

By the end of the course the students should be able to:

CO1: To explore fundamental image processing techniques required for computer vision
CO2: Understand Image formation process and Generate 3D model from images.

CO3: Perform feature extraction and motion estimation on the images.

CO4: To perform shape analysis and perform segmentation.

CO5: Perform Object Analysis and do processing.

Unit-I Introduction :

Image Processing, Computer Vision and Computer Graphics , What is Computer Vision - Low-level, Mid-level, High-level , Overview of Diverse Computer Vision Applications: Document Image Analysis, Biometrics, Object Recognition, Tracking, Medical Image Analysis, Content-Based Image Retrieval, Video Data Processing, Multimedia, Virtual Reality and Augmented Reality.

Unit-II : Image Formation Models : Monocular imaging system , Radiosity: The 'Physics' of Image Formation, Radiance, Irradiance, BRDF, color etc, Orthographic & Perspective Projection,• Camera model and Camera calibration, Binocular imaging systems, Multiple views geometry, Structure determination, shape from shading , Photometric Stereo, Depth from Defocus , Construction of 3D model from images.

Unit-III :

Image Processing , Feature Extraction and Motion Estimation : Image preprocessing, Image representations (continuous and discrete) , Edge detection, Regularization theory , Optical computation , Stereo Vision , Motion estimation , Structure from motion

Unit-IV :

Shape Representation and Segmentation : Contour based representation, Region based representation, Deformable curves and surfaces , Snakes and active contours, Level set representations , Fourier and wavelet descriptors , Medial representations , Multiresolution analysis.

Unit-V

Object recognition and Image understanding: Hough transforms and other simple object recognition methods, Shape correspondence and shape matching, Principal component analysis , Shape priors for recognition, Pattern recognition methods, HMM, GMM and EM.

Text Books:

1. Computer Vision - A modern approach, by D. Forsyth and J. Ponce, Prentice Hall Robot Vision, by B. K. P. Horn, McGraw-Hill
2. Introductory Techniques for 3D Computer Vision, by E. Trucco and A. Verri, Publisher: Prentice Hall.
3. R. C. Gonzalez, R. E. Woods. Digital Image Processing. Addison Wesley Longman, Inc., 1992
4. D. H. Ballard, C. M. Brown. Computer Vision. Prentice-Hall, Englewood Cliffs, 1982.

OEEE-811	Metro Systems and Engineering	L-T-P-C: 4-0-0-4
Course Outcomes: At the end of this course students will demonstrate the ability to		
CO1	Understand the basic plan of metro systems	
CO2	Aware of the construction methods, quality and safety systems	
CO3	Comprehend the SCADA based signalling system	
CO4	Understand vehicle dynamics, ventilation, fire safety	
CO5	Relate with the Power Supply and Back-up systems	

UNIT I GENERAL

Overview of Metro Systems; Need for Metros; Routing studies; Basic Planning and Financials

UNIT II CIVILENGINEERING

Overview and construction methods for: Elevated and underground Stations; Viaduct spans and bridges; Underground tunnels; Depots; Commercial and Service buildings. Initial Surveys & Investigations; Basics of Construction Planning & Management, Construction Quality & Safety Systems - Traffic integration, multimodal transfers and pedestrian facilities; Environmental and social safeguards; Track systems-permanent way. Facilities Management

UNIT III ELECTRONICS AND COMMUNICATION ENGINEERING

Signaling systems; Automatic fare collection; Operation Control Centre (OCC and BCC); SCADA and other control systems; Platform Screen Doors

UNIT IV MECHANICAL & TV + AC:

Rolling stock, vehicle dynamics and structure; Tunnel Ventilation systems; Air conditioning for stations and buildings; Fire control systems; Lifts and Escalators

UNIT V ELECTRICAL:

OHE, Traction Power; Substations- TSS and ASS; Power SCADA; Standby and Back-up systems; Green buildings, Carbon credits and clear air mechanics**.**

Reference Books:

1. Railway Engineering, Rangwala, Charotat Publishing
2. Civil Engineering for Underground Rail Transport, J.T. Edwards, Science Direct
3. **http://www.railsystem.net/electric-traction-systems/**

OEC-812	Speech and Audio Processing	L-T-P-C: 4-0-0-4
Course Outcomes: At the end of this course students will demonstrate the ability to		
CO1	Mathematically model the speech signal	
CO2	Analyze the quality and properties of speech signal	
CO3	Modify and enhance the speech and audio signals	

UNIT I

Introduction- Speech production and modeling - Human Auditory System; General structure of speech coders; Classification of speech coding techniques – parametric, waveform and hybrid ; Requirements of speech codecs –quality, coding delays, robustness.

UNIT II

Speech Signal Processing- Pitch-period estimation, all-pole and all-zero filters, convolution; Power spectral density, periodogram, autoregressive model, autocorrelation estimation.

Linear Prediction of Speech- Basic concepts of linear prediction; Linear Prediction Analysis of non-stationary signals –prediction gain, examples; Levinson-Durbin algorithm; Long term and short-term linear prediction models; Moving average prediction.

UNIT III

Speech Quantization- Scalar quantization–uniform quantizer, optimum quantizer,logarithmicquantizer, adaptive quantizer, differential quantizers; Vector quantization – distortion measures, codebook design, codebook types.

Scalar Quantization of LPC- Spectral distortion measures, Quantization based onreflection coefficient and log area ratio, bit allocation; Line spectral frequency – LPC to LSF conversions, quantization based on LSF.

UNIT IV

Linear Prediction Coding- LPC model of speech production; Structures of LPCencoders and decoders; Voicing detection; Limitations of the LPC model.

UNIT V

Code Excited Linear Prediction-CELP speech production model; Analysis-by-synthesis; Generic CELP encoders and decoders; Excitation codebook search – state-save method, zero-input zero-state method; CELP based on adaptive codebook, Adaptive Codebook search; Low Delay CELP and algebraic CELP.

Speech Coding Standards-An overview of ITU-T G.726, G.728 and G.729standards

Text/Reference Books:

1. "Digital Speech" by A.M.Kondoz, Second Edition (Wiley Students‟ Edition), 2004.
2. "Speech Coding Algorithms: Foundation and Evolution of Standardized Coders", W.C. Chu, WileyInter science, 2003.

B.E II Year (Semester-III) Electrical Engineering
Course Structure & Evaluation Scheme

Sl. No.	Category	Course Code	Course Title	Contact Hours			Sessional Marks			End Semester Marks			Credits
				L	T	P	CT	TA	Total	TE	PE	Total	
1	BSC	BSC-301	Mathematics III	3	1	0	30	10	40	60	-	100	**4**
2	PCC	BEE-301	Network Analysis and Synthesis	3	1	0	30	10	40	60	-	100	**4**
3	PCC	BEE-302	Electrical Machines - I	3	0	0	30	10	40	60	-	100	**3**
4	PCC	BEE-303	Solid state Devices and Circuits	3	0	0	30	10	40	60	-	100	**3**
5	ESC	BEC-301	Digital Electronics	3	0	0	30	10	40	60	-	100	**3**
6	MC	MC-302	Human Values and Professional Ethics	2	0	0	30	10	40	60	-	100	**0**
7	ESC	BEC-351	Digital Electronics Lab	0	0	2	20	20	40	-	60	100	**1**
8	PCC	BEE-351	Electrical Machines Lab - I	0	0	2	20	20	40	-	60	100	**1**
9	PCC	BEE-352	Solid state Devices and Circuits Lab	0	0	2	20	20	40	-	60	100	**1**
10	Project/ Internship	BEE-353	Mini-project/ Internship Assessment	0	0	0	-	-	100	-	-	100	**2**
			Total									**1000**	**22**

B.E II Year (Semester-IV) Electrical Engineering
Course Structure & Evaluation Scheme

Sl. No.	Category	Course Code	Course Title	Contact Hours			Sessional Marks			End Semester Marks			Credits
				L	T	P	CT	TA	Total	TE	PE	Total	
1	PCC	BEE401	Electrical Measurements & Instruments	3	1	0	30	10	40	60	-	100	4
2	ESC	BEC404	Linear Integrated circuits	3	0	0	30	10	40	60	-	100	3
3	PCC	BEE402	Electrical Machines- II	3	1	0	30	10	40	60	-	100	4
4	PCC	BEE403	Electromagnetic Theory	3	1	0	30	10	40	60	-	100	4
5	ESC	BCS402	Data Structures and Algorithms	3	0	0	30	10	40	60	-	100	3
6	MC	MC401	Environment and Ecology	2	0	0	30	10	40	60	-	100	0
7	PCC	BEE451	Electrical Measurements & Instruments Lab	0	0	2	20	20	40	-	60	100	1
8	ESC	BEC454	Linear Integrated Circuits Lab	0	0	2	20	20	40	-	60	100	1
9	PCC	BEE452	Electrical Machines Lab- II	0	0	2	20	20	40	-	60	100	1
10	ESC	BCS452	Data Structures and Algorithms Lab	0	0	2	20	20	40	-	60	100	1
			Total									**1000**	**22**

B.E III Year (Semester-V) Electrical Engineering
Course Structure & Evaluation Scheme

Sl. No.	Category	Course Code	Course Title	Contact Hours			Sessional Marks			End Semester Marks			Credits
				L	T	P	CT	TA	Total	TE	PE	Total	
1	PCC	BEE501	Power Systems I	3	0	0	30	10	40	60	-	100	**3**
2	PCC	BEE502	Signals and Systems	2	0	0	30	10	40	60	-	100	**2**
3	PCC	BEE503	Microprocessors and Microcontrollers	3	0	0	30	10	40	60	-	100	**3**
4	PEC	DEEE50X	Program Elective – 1	3	0	0	30	10	40	60	-	100	**3**
5	OEC	OEEE50X	Open Elective – I	3	0	0	30	10	40	60	-	100	**3**
6	HSMC	BHSM501	Economics for Industry	3	0	0	30	10	40	60	-	100	**3**
7	PCC	BEE551	Power Systems Lab I	0	0	2	30	10	40	-	60	100	**1**
8	PCC	BEE552	Electronics Design Lab	0	0	2	30	10	40	-	60	100	**1**
9	PCC	BEE553	Microprocessors, Microcontrollers Lab	0	0	2	30	10	40	-	60	100	**1**
10	Project/Internship	BEE554	Internship Assessment	0	0	0	0	0	100	0	0	100	**2**
			Total									**1000**	**22**

B.E III Year (Semester-VI) Electrical Engineering
Course Structure & Evaluation Scheme

Sr. No.	Category	Course Code	Course Title	Contact Hours			Sessional Marks			End Semester Marks			Credits
				L	T	P	CT	TA	Total	TE	PE	Total	
1	PCC	BEE601	Power Systems II	3	1	0	30	10	40	60	-	100	**4**
2	PCC	BEE602	Automatic Control Systems	3	1	0	30	10	40	60	-	100	**4**
3	PCC	BEE603	Power Electronics and Drives	3	1	0	30	10	40	60	-	100	**4**
4	MC	MC601	Occupational Health and Safety	3	0	0	30	10	40	60	-	100	**0**
5	PEC	DEEE60X	Program Elective – 2	3	1	0	30	10	40	60	-	100	**4**
6	OEC	OEEE60X	Open Elective -2	3	0	0	30	10	40	60	-	100	**3**
7	PCC	BEE651	Power System II Lab	0	0	2	20	20	40	-	60	100	**1**
8	PCC	BEE652	Automatic Control Systems Lab	0	0	2	20	20	40	-	60	100	**1**
9	PCC	BEE653	Power Electronics and Drives Lab	0	0	2	20	20	40	-	60	100	**1**
			Total									**900**	**22**

B.E IV Year (Semester-VII) Electrical Engineering
Course Structure & Evaluation Scheme

Sr. No.	Category	Course Code	Course Title	Contact Hours			Sessional Marks			End Semester Marks			Credits
				L	T	P	CT	TA	Total	TE	PE	Total	
1	PCC	BEE701	Digital Signal Processing	3	0	0	30	10	40	60	-	100	**3**
2	PCC	BEE702	Advanced Electrical Drives	2	0	0	30	10	40	60	-	100	**2**
3	PCC	BEE703	Power System Operation and Control	3	0	0	30	10	40	60	-	100	**3**
4	PEC	DEEE70X	Program Elective -3	3	1	0	30	10	40	60	-	100	**4**
5	OEC	OEEE70X	Open Elective-3	3	0	0	30	10	40	60	-	100	**3**
6	PCC	BEE751	Digital Signal Processing Lab	0	0	2	20	20	40	-	60	100	**1**
7	Internship	BEE752	Internship Assessment	0	0	0	0	0	40		60	100	**3**
8	Project/Internship	PROJEE1	Project Stage-I	0	0	-	-	-	100	-	0	100	**3**
			Total									**800**	**22**

B.E IV Year (Semester-VIII) Electrical Engineering
Course Structure & Evaluation Scheme

Sr. No.	Category	Course Code	Course Title	Contact Hours			Sessional Marks			End Semester =Marks			Credits
				L	T	P	CT	TA	Total	TE	PE	Total	
1	PCC	BEE801	Industrial Electrical Systems	2	0	0	30	10	40	60	-	100	**2**
2	PEC	DEEE80X	Program Elective - 4	3	1	0	30	10	40	60	-	100	**4**
3	OEC	OEEE80X	Open Elective -4	3	0	0	30	10	40	60	-	100	**3**
4	HSMC	BHSM804	Principles of Management	3	0	0	30	10	40	60	-	100	**3**
5	PCC	BEE851	Electrical CAD and Fabrication Lab	0	0	2	20	20	40	-	60	100	**1**
6	Seminar	BEE852	Seminar on cutting end technology	0	0	0	-	-	100	-	-	100	**2**
7	Project/ Internship	PROJEE2	Project Stage-II	0	0		-	-	50	-	50	100	**7**
			Total									**700**	**22**

*** Labview, MATLAB should be provided for Laboratory**

Program Electives – Department of Electrical Engineering

(Study through MOOCs allowed)

Program Elective - 1	
DEEE501	Micro Electro Mechanical Systems
DEEE502	Introduction to Power Plant Engineering
DEEE503	Electrical Engineering materials
DEEE504	Artificial Intelligence
Program Elective - 2	
DEEE601	Soft Computing
DEEE602	Digital Image and Video Processing
DEEE603	High Voltage Engineering
DEEE604	Electrical Machine Design
Program Elective - 3	
DEEE701	Wind and Solar Energy
DEEE702	Digital Control Systems
DEEE703	Microcontrollers and Embedded Systems
DEEE704	Energy Audit
DEEE705	EHV AC and DC Transmission
Program Elective - 4	
DEEE801	Power Quality and FACTS
DEEE802	Analog and Digital Communication
DEEE803	Medical Instrumentation
DEEE804	Speech and Audio Processing
DEEE805	

III SEMESTER

BCS-301 MATHEMATICS-III (L-T-P-C: 3-1-0-4)
III SEMESTER (ECE, CSE, EE, ME, CE)

L T P
3 1 0 4

Course Details:

Unit – I:

Fourier Transform : (9 Hours)

Fourier integral, conditions of convergence, Fourier sine and cosine integrals, complex form, applications, Inversion formula for Fourier transform, operational properties. Discrete and Fast Fourier transform. Applications of Fourier transform to solve boundary value problems.

Unit- II:

Functions of a Complex Variable and Conformal mapping: (10 Hours)

Limit, Continuity, Differentiability and Analyticity of functions of a complex variable, Cauchy-Riemann equations, Harmonic functions, Complex functions as mappings, Linear Transformation, Inverse transformation, Bilinear Transformations, Conformal Mapping & applications.

Unit- III:

Integration of Complex Functions: (10 Hours)

Contour integrals and evaluations, Cauchy's Theorem, Cauchy's Integral Formulae, Liouville's theorem, Convergence of power series, Taylor series, Laurent series, Zeros and Singularities of a complex function, Residues and Residue theorem, Evaluation of definite and improper integrals.

Unit- IV:

Curve- Fitting & Probability: (8 Hours)

Curve-fitting: method of least- squares, Normal equations, Normal equation in case of straight line, Fitting a straight line, Polynomial, non-linear and exponential curves, Change of origin.

Probability: Basics of probability, random variables, Expectation, Baye's theorem and probability distributions, Binomial, Poisson and Normal distributions.

Unit- V:

Statistical Methods: (8 Hours)

Sampling Theory, Parameters of Statistics, Tests of hypothesis and significance, z-test, t-test, $\chi 2$- **test ,**Goodness of fit test**,** Time series analysis, Index numbers, Quality control chart and acceptance sampling, Introduction to design of experiments, Forecasting models.

Books Recommended:

1.R.K. Jain & S.R.K. Iyengar; Advanced Engineering Mathematics, Narosa Publishing House, 2002.
2.Erwin Kreyszig; Advanced Engineering Mathematics, John Wiley & Sons, 1962.
3.R.V. Churchill and J.L. Brown, Complex Variables and Applications, McGraw Hill, 1990.
4.B.S.Grewal, Higher Engineering Mathematics, Khanna Publisher, 2005.

5.J.H. Mathews and R.W. Howell, Complex analysis for Mathematics and Engineering, 3rd Ed. Narosa, 1998.

BEE-301 NETWORK ANALYSIS AND SYNTHESIS (L-T-P-C: 3-1-0-4)

Unit – I: Graph Theory (8 Hours)

Graph of a network, Definitions, Tree, Co tree, Link, basic loop and basic cut set, Incidence matrix, Cut set matrix, Tie set matrix, Node and Mesh Analysis with dependent current and voltage sources. Mutual coupled circuits, Dot Convention in coupled circuits

Unit – II: Network Theorems - Applications to AC Networks (8 hours)

Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem, Reciprocity theorem, Millman's theorem, Compensation theorem, Concept of duality and dual networks

Unit – III: Network Transient and steady state analysis (10 Hours)

Solution of first and second order differential equations for Series and parallel R-L, R-C, R-L-C circuits, initial and final conditions in network elements, forced and free response, time constants, steady state and transient state response, Evaluation of time response both through classical and Laplace methods

Unit – IV Network Functions (8 Hours)

Concept of complex frequency, Transform impedances network functions of one port and two port networks, Concept of poles and zeros, Properties of driving point and transfer functions.

Two Port Networks- Characterization of LTI two port networks; Z, Y, ABCD, A'B'C'D', g and h parameters, Reciprocity and symmetry, Inter-relationships between the parameters, Interconnections of two port networks, Ladder and Lattice networks: T & Π representation

Unit – V Network Synthesis (6 Hours)

Positive real function; definition and properties, Properties of LC, RC and RL driving point functions, Synthesis of LC, RC and RL driving point immittance functions using Foster and Cauer first and second forms

Text Books:

1. M. E. Van Valkenburg, "Network Analysis", Prentice Hall of India
2. Alexander, Sadiku, "Fundamentals of Electric Circuits", McGraw Hill
3. D. Roy Choudhary, "Networks and Systems", Wiley Eastern Ltd.
4. C. L. Wadhwa, "Network Analysis and Synthesis", New Age International Publishers
5. A. Chakrabarti, "Circuit Theory", Dhanpat Rai & Co.

Reference Books:

1. Hayt, Kimmerly, Durbin, "Engineering Circuit Analysis", McGraw Hill
2. Donald E. Scott, "An Introduction to Circuit analysis: A System Approach", McGraw Hill

3. M. E. Van Valkenburg, “An Introduction to Modern Network Synthesis”, Wiley Eastern Ltd.
4. T. S. K. V. Iyer, “Circuit Theory”, Tata McGraw Hill 5. Joseph A. Edminister, “ Theory & Problems of Electric Circuits”, McGraw Hill

BEE-302 ELECTRICAL MACHINES-I (L-T-P-C: 3-0-0-3)

Unit – I: Electro-Mechanical Energy Conversion (6 Hours)

Faraday's law and Lenz's law - time varying and rotational induced emfs – Energy balance, energy and coenergy – force and torque – singly and doubly excited systems – reluctance and mutual torques.

Unit – II: Basic Concepts in Electrical Machines (9 Hours)

Construction – Principle of operation - Windings: D.C Machine armature winding (lap and wave connection), field winding – MMF pattern of armature winding and field winding – Magnetic fields in rotating machinery - EMF and torque equations – losses in machines – armature reaction – commutation – Inter-poles and compensating windings

Unit – III: DC machine - motoring and generation (9 Hours)

Armature circuit equation for motoring and generation – methods of excitation, equivalent circuits and characteristics of generators and motors – testing and efficiency – starting - speed control, Ward-Leonard control - braking, Permanent Magnet DC Machines

Unit – IV: Transformers (8 Hours)

Principle, construction and operation of single-phase transformers, equivalent circuit, phasor diagram, voltage regulation, losses and efficiency Testing - open circuit and short circuit tests, polarity test, back-to-back test
Three-phase transformer - construction, types of connection and their comparative features, Parallel operation of single-phase and three-phase transformers

Unit – V: Special Purpose Transformers (8 Hours)

Autotransformers - construction, principle, applications and comparison with two winding transformer, Phase conversion - Scott connection, three-phase to six-phase conversion, Tap-changing transformers - No-load and on-load tap-changing of transformers, Three-winding transformers, Instrument Transformers.
Harmonics and switching transients in transformers, effect of transformer connections, inrush current, cooling of transformers

Text / References

1. I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.
2. A. E. Fitzgerald and C. Kingsley, "Electric Machinery", New York, McGraw Hill Education, 2013.

3. A. E. Clayton and N. N. Hancock, "Performance and design of DC machines", CBS Publishers, 2004.
4. M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.

5. P. S. Bimbhra, “Electrical Machinery”, Khanna Publishers, 2011.

BEE-303 SOLID STATE DEVICES AND CIRCUITS (L-T-P-C: 3-0-0-3)

Unit – I: PN junction Devices (7 Hours)

PN junction diode – structure, operation and V-I characteristic – current equation – drift current density and diffusion current density – diffusion and transient capacitance – Zener breakdown – zener reverse characteristic – zener as regulator; Optoelectronic devices - LED, LCD and LASER

Unit – II: BJT circuits (8 Hours)

Structure and I-V characteristics of a BJT; BJT as a switch, BJT as an amplifier: small-signal model, biasing circuits, current mirror; common-emitter, common-base and common-collector amplifiers; Small signal equivalent circuits, high-frequency equivalent circuits

Unit – III: MOSFET circuits (8 Hours)

MOSFET structure and I-V characteristics; MOSFET as a switch, MOSFET as an amplifier: small-signal model and biasing circuits, common-source, common-gate and common-drain amplifiers; small signal equivalent circuits - gain, input and output impedances, trans-conductance, high frequency equivalent circuit.

Unit – IV: Feed-back amplifiers and oscillators (9 Hours)

Principles of feedback in amplifiers advantages of negative feedback, Classification of feedback, voltage series, and voltage shunt, current series, Current – shunt effect of feedback on input and output impedance, Gain, stability, noise, distortion and band width Barkhausen criterion for sinusoidal oscillators. Phase shift oscillator. Wein-bridge oscillator, Hartley oscillator, Colpitts oscillator, crystal oscillator, frequency stability

Unit – V: Power Amplifiers (9 Hours)

Classification of Output stages A/B/AB, single-ended and Push-Pull Configuration, Power dissipation and Output Power conversion efficiencies, complimentary-symmetry Power Amplifier. Power BJTs, MOS Power Transistors, Temperature effects
Tuned Amplifiers:, Tuned Voltage Amplifier, single and double tuned amplifiers, Class-C Amplifier, RF Amplifiers.

Text/References:

1. S. Sedra and K. C. Smith, “Microelectronic Circuits”, New York, Oxford University Press, 1998.
2. David A. Bell, Electronic devices and circuits, Prentice Hall of India, 2004.
3. Rashid, Microelectronic circuits, Thomson publications, 1999
4. J. Millman and A. Grabel, “Microelectronics”, McGraw Hill Education, 1988.
5. Boylstad & Neshlshky/Electronics Devices & Circuits/PHI
6. P. Horowitz and W. Hill, “The Art of Electronics”, Cambridge University Press, 1989.

BEC-301 DIGITAL ELECTRONICS (L-T-P-C: 3-0-0-3)

Unit I : Digital Fundamentals (8 Hours)

Number Systems – Decimal, Binary, Octal, Hexadecimal, 1„s and 2„s complements, Codes – Binary, BCD, Excess 3, Gray, Alphanumeric codes, Boolean theorems, Logic gates, Universal gates, Sum of products and product of sums, Minterms and Maxterms, Karnaugh map Minimization and Quine-McCluskey method of minimization.

Unit II : Combinational Logic Design (8 Hours)

Design Examples: Arithmetic Circuits, BCD - to – 7 segment decoder, Code converters. Adders and their use as subtractor, look ahead carry, Digital Comparator, Parity generators/checkers, Multiplexers and their use in combinational logic designs, multiplexer , De-multiplexers and their use in combinational logic designs, Decoders, demultiplexer.

Unit III : Sequential Logic Design (9 Hours)

1 Bit Memory Cell, Clocked SR, JK, MS J-K flip flop, D and T flip-flops. Use of preset and clear terminals, Excitation Table for flip-flops, Conversion of flip flops, Application of Flip flops: Registers, Shift registers, Counters, Sequence Generators, ripple counters, up/down counters, synchronous counters. Basic design steps- State diagram, State table, State reduction, State assignment, Mealy and Moore machines representation, Implementation, finite state machine implementation

Unit IV : Digital Logic Families (8 Hours)

Classification of logic families, Characteristics of digital ICs-Speed of operation, power dissipation, figure of merit, fan in, fan out, current and voltage parameters, noise immunity, operating temperatures and power supply requirements. TTL logic. Operation of TTL NAND gate, active pull up, wired AND, open collector output. Tri-State logic. CMOS logic – CMOS inverter, NAND, NOR gates, wired logic , open drain output. Interfacing CMOS and TTL. Comparison table of Characteristics of TTL, CMOS, ECL, RTL, I2L, DCTL.

Unit V : Programmable Logic Devices and Semiconductor Memories (7 Hours)

Programmable logic devices: Detail architecture, Study of PROM, PAL, PLA, Designing combinational circuits using PLDs. General Architecture of FPGA and CPLD Semiconductor memories: memory organization and operation, expanding memory size, Classification and characteristics of memories, RAM,ROM,EPROM, EEPROM, NVRAM, SRAM,DRAM.

TextBooks:

1. R.P. Jain , “Modern digital electronics” , 3rd edition , 12threprint Tata McGraw Hill Publication, 2007.
2. M. Morris Mano, “Digital Logic and Computer Design” 4th edition, Prentice Hall of India, 2013.

Reference:

1. Anand Kumar, “Fundamentals of digital circuits” 1st edition, Prentice Hall of India, 2001
2.Tokheim, H. Roger L. /“Digital Electronics Principles & Application”/ Tata McGraw-Hill / 6th Ed.
3. NPTEL video lectures on Digital Circuits.

MC302/MC402 Human Values and Professional Ethics(L-T-P-C: 2-0-0-0)

UNIT-1

Course Introduction - Need, Basic Guidelines, Content and Process for Value Education Understanding the need, basic guidelines, content and process for Value Education, Self-Exploration–what is it? - its content and process; 'Natural Acceptance' and Experiential Validation- as the mechanism for self-exploration, Continuous Happiness and Prosperity- A look at basic Human Aspirations, Right understanding, Relationship and Physical Facilities- the basic requirements for fulfilment of aspirations of every human being with their correct priority, Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario, Method to fulfill the above human aspirations.

UNIT-2

Understanding Harmony in the Human Being - Harmony in Myself Understanding human being as a co-existence of the sentient 'I' and the material 'Body', Understanding the needs of Self ('I') and 'Body' - Sukh and Suvidha, Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer), Understanding the characteristics and activities of 'I' and harmony in 'I', Understanding the harmony of I with the Body: Sanyam and Swasthya; correct appraisal of Physical needs, meaning of Prosperity in detail, Programs to ensure Sanyam and Swasthya.

UNIT-3

Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship Understanding harmony in the Family- the basic unit of human interaction, Understanding values in human-human relationship; meaning of Nyaya and program for its fulfillment to ensure Ubhay-tripti (Mutual Happiness); Trust (Vishwas) and Respect (Samman) as the foundational values of relationship, Understanding the meaning of Vishwas; Difference between intention and competence, Understanding the meaning of Samman, Difference between respect and disrespect; the other salient values in relationship, Understanding the harmony in the society (society being an extension of family): Samadhan, Samridhi, Abhay, Sah-astitva as comprehensive Human Goals, Visualizing a universal harmonious order in society.

UNIT-4

Understanding Harmony in the Nature and Existence - Whole existence as Co-existence Understanding the harmony in the Nature, Interconnectivity and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature, Understanding Existence as Co-existence (Sah-astitva) of mutually interacting units in all-pervasive space, Holistic perception of harmony at all levels of existence.

UNIT-5

Implications of the Holistic Understanding of Harmony on Professional Ethics Natural acceptance of human values, Definitiveness of Ethical Human Conduct, Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order,

Competence in Professional Ethics: a) Ability to utilize the professional competence for augmenting universal human order, b) Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems, technologies and management models; Improving quality of work life at work place.

Text Books:

1. R R Gaur, R Sangal, G P Bagaria, 2009, A Foundation Course in Human Values and Professional Ethics.

References:

1. A Nagraj, 1998, Jeevan Vidya Ek Parichay, Divya Path Sansthan, Amarkantak
2. R. Subramanian,2017, Professional Ethics,
3. P L Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Publishers.
4. A N Tripathy, 2003, Human Values, New Age International Publishers.
5. SubhasPalekar, 2000, How to practice Natural Farming, Pracheen (Vaidik) KrishiTantraShodh, Amravati.
6. E G Seebauer & Robert L. Berry, 2000, Fundamentals of Ethics for Scientists & Engineers , Oxford University Press
7. M Govindrajran, S Natrajan & V.S. Senthil Kumar, Engineering Ethics (including Human Values), Eastern Economy Edition, Prentice Hall of India Ltd.
8. B P Banerjee, 2005, Foundations of Ethics and Management, Excel Books.
9. B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008.

BEC-351 **Digital Electronics Lab** **(L-T-P-C: 0-0-2-1)**

List of experiment

1.To study about logic gate and verify their Truth table.

2.To design and implement half adder and full adder.

3.To design and implement half subtractor and full subtractor

4.To design and implement 8:1 MUX.

5.To design and implement 1:8 DEMUX.

6.To design and implement Encoder.

7.To design and implement Decoder.

8.To design and implement R-S flip flop and J K flip flop

9.To design and implement D & T flip flop

10.To design and implement Master -Slave flip flop

11.To design and implement SISO AND SIPO.

12.To design and implement PISO and PIPO.

13.To design and implement DECAD counter

BEE-351 **Electrical Machines Lab –I** **(L-T-P-C: 0-0-2-1)**

List of Experiments:

1. Determination of circuit parameters and loss in single phase transformer by OC test
2. Determination of circuit parameters in single phase transformer by SC test
3. Measurement of efficiency ad Voltage Regulation of transformer
4. Magnetization characteristic of DC shunt generator
5. Load Test on DC shunt generator
6. Load Test on DC series generator
7. Load Test on DC compound generator
8. Speed control of dc shunt motor by field control method
9. Speed control of dc shunt motor by armature control method
10. Hopkinson's test on DC shunt machines
11. Characteristics of DC shunt generator using digital simulation
12. Load test on DC shunt generator using digital simulation
13. Speed control techniques of DC motor using programmable logic controller and Lab VIEW

BEE-352 SOLID-STATE DEVICE & CIRCUIT LAB (L-T-P-C: 0-0-2-1)

List of Experiments:

1. Study of Lab Equipment and Components: CRO, Multimeter, and Function Generator, Power supply- Active, Passive Components and Bread Board.

2. P-N Junction diode: Characteristics of PN Junction diode - Static and dynamic resistance measurement from graph.

3. Applications of PN Junction diode: Half & Full wave rectifier- Measurement of Vrms, Vdc, and ripple factor.

4. Characteristics of Zener diode: V-I characteristics of Zener diode, Graphical measurement of forward and reverse resistance.

5. Application of Zener diode: Zener diode as voltage regulator. Measurement of percentage regulation by varying load resistor.

6. Characteristic of BJT: BJT in CE configuration- Graphical measurement of h-parameters from input and output characteristics. Measurement of Av, AI, Ro and Ri of CE amplifier with potential divider biasing.

7. Field Effect Transistors: Single stage Common source FET amplifier –plot of gain in dB Vs frequency, Measurement of, bandwidth, input impedance, maximum signal handling capacity (MSHC) of an amplifier.

10. Oscillators: Sinusoidal Oscillators

    a. Wein bridge oscillator

    b. phase shift oscillator.

11. Simulation of Amplifier circuits studied in the lab using any available simulation software.

IV SEMESTER

BEE-401 ELECTRICAL MEASUREMENTS AND INSTRUMENTS L-T-P-C: 3-0-0-4

Unit – I: Introduction to Measurement (8 Hours)

Measurement system, Methods of measurement, Classification of instrument systems, Characteristics of instruments, Unit, Dimensions, Standards, Scientific notations
Introduction to Error, Errors in Measurement & Measurement standards, Gross error, Systematic error, Absolute error, Relative error, Accuracy, Precision, Resolution, Measurement error combination

Unit – II: Transducers (8 Hours)

Transducers, Definition, Types of transducers, Selection of transducers, Advantages of transducers, Applications of transducers, Characteristics, Factors affecting the choice of transducers, Strain gauges, Resistance thermometer, Thermistors, Thermocouples, Linear variable differential transformer, Inductive transducers, Capacitive transducers, Piezoelectric transducers.

Unit – III: Measuring Instruments (8 Hours)

Electronic digital multimeter, Digital frequency meter system, Galvanometer, Voltmeter, Ammeter, Ohm meter, Energy meter, Q-meter

Measurement of Resistance: Resistance measurement, Measurement of low, medium and high resistances, Wheatstone bridge.

Measurement of Inductance And Capacitance: AC bridges for inductance measurement, AC bridges for capacitance measurement, Applications of bridges in measurement system.

Unit – IV: Display Devices (8 Hours)

Cathode Ray Oscilloscope (CRO): Circuit (Block diagram), Cathode Ray Tube (CRT) & its components, Applications of CRO in measurement, Measurement of voltage, frequency and phase by CRO, Types of CRO, Digital Storage Oscilloscope (DSO), Applications of Digital Storage Oscilloscope

Special Devices: Spectrum Analyzer, Logic Analyzer, Digital Multimeter as a standard instrument, Data Loggers, Digital Read Out Systems, Digital Input-Output devices.

Unit – V: Telemetry and Data Acquisition Systems (8 Hours)

Introduction to telemetry, Telemetry types, Landline telemetry, Radio telemetry, Telemetry applications. Introduction to Data acquisition systems, Data acquisition systems types, Analog Data acquisition systems and Digital Data acquisition systems, Data acquisition systems applications.

Text / Reference Books

1. A. K. Sawhney, “Advanced Measurements & Instrumentation”, Dhanpat Rai & Sons
2. Rajendra Prasad, “Electronic Measurement and Instrumentation Khanna Publisher
3. M.M.S. Anand, “Electronic Instruments and Instrumentation Technology” PHI Learning.

4. W. D. Cooper and A.P. Beltried, “Electronics Instrumentation and Measurement Techniques” Prentice Hall International
5. David A. Bell, “Electronic Instrumentation and Measurements”, Oxford University Press.
6. Oliver and Cage, “Electronic Measurements and Instrumentation”, Tata McGraw Hill Publication.
7. Alan S. Morris, “Measurement and Instrumentation Principles”, Elsevier (Butterworth Heinmann).

BEC-404 LINEAR INTEGRATED CIRCUITS L T P C 3 0 0 3

Unit I: OP-AMP Basics (9 Hours)

Introduction, , Differential Amplifier configurations, DC & AC analysis of all Differential amplifier configurations, Swamping resister, Constant current Bias, Current Mirror Circuits, Level Translator. Block diagram of OP-AMP. Op-amp internal circuit, Basic information of Op-amp, Op-amp characteristics**,** Voltage series and voltage shunt feedback amplifier and its effect on Ri, Ro, bandwidth and voltage gain.

Unit II : Linear & Non-linear Applications of OP-AMP (9 Hours)

Inverting and Non-inverting amplifier, voltage follower. Summing, averaging, scaling amplifier, difference amplifier, Ideal integrator, practical integrator with frequency response, Ideal differentiator, practical differentiator with frequency response, Instrumentation amplifiers. Comparator, Schmitt trigger, clippers and clampers, voltage limiters, Square wave generator, triangular wave generator, peak detectors, sample and hold circuits.

Unit III : Filters & Oscillators (9 Hours)

Types of filter (LP,HP,BP, and Notch), first order & second order low-pass & High-pass filter. Oscillators principle, types and frequency stability, design of phase shift, wein bridge, Quadrature, voltage controlled oscillators.

Unit IV : Voltage Regulator & Converters (9 Hours)

Transistorized series-pass Regulator, overload short circuit protection, fixed & adjustable voltage regulators (LM317, 723 regulators), SMPS V-F, I-V and V-I converter, DAC: types of DAC, Weighted resister, R-2R ladder. ADC: types of ADC, Flash type, counter type, successive approximation resister.

Unit V : Signal generators and wave shaping circuits (9 Hours)

IC Timer-555, internal structure, pin diagram, monostable and astable operation. 565 Phase locked loop PLL, Block diagram of PLL and its function, VCO, Phase detector, applications of PLL, ICL 8038 function generator IC, isolation amplifiers, opto coupler, opto electronic ICs.

TEXT BOOKS:

1. Ramakant A.Gayakwad, Op-amps and Linear Integrated Circuits, IV edition, Pearson Education, 2009 / PHI.
2. D. Roy Choudhery, Sheil B. Jain, Linear Integrated Circuits, second edition, New Age publishers, 2010.

REFERENCES:

1. Robert F Coughlin, Fredrick, F. Driscold, Opamp and linear ICs, Pearson education, 4th edition, 2002.
2. David A Bell, Opamp and linear ICs, second edition, Prentice hall of India,1997.
   David L Terrel, Opamps – design, applications and trouble shooting, Elsevier 2007.

BEE-402 ELECTRICAL MACHINES – II (L-T-P-C: 3-1-0-4)

UNIT-I Synchronous Generator (8 Hours)

Constructional details – Types of rotors –winding factors- emf equation – Synchronous reactance – Armature reaction – Phasor diagrams of non-salient pole synchronous generator connected to infinite bus–Synchronizing and parallel operation – Synchronizing torque -Change of excitation and mechanical input- Voltage regulation – EMF, MMF, ZPF and A.S.A methods – steady state power- angle characteristics– Two reaction theory –slip test -short circuit transients – Capability Curves

UNIT II Synchronous Motor (8 Hours)

Principle of operation – Torque equation – Operation on infinite bus bars – V and Inverted V curves – Power input and power developed equations – Starting methods – Current loci for constant power input, constant excitation and constant power developed-Hunting – natural frequency of oscillations – damper windings- synchronous condenser.

UNIT III Three Phase Induction Motor (8 Hours)

Constructional details – Types of rotors –- Principle of operation – Slip –cogging and crawling-Equivalent circuit – Torque-Slip characteristics – Condition for maximum torque – Losses and efficiency – Load test – No load and blocked rotor tests – Circle diagram – Separation of losses – Double cage induction motors –Induction generators – Synchronous induction motor. Need for starting – Types of starters – DOL, Rotor resistance, Autotransformer and Star-delta starters – Speed control – Voltage control, Frequency control and pole changing – Cascaded connection-V/f control – Slip power recovery scheme-Braking of three phase induction motor: Plugging, dynamic braking and regenerative braking.

UNIT IV Single Phase Induction Motors (8 Hours)

Constructional details of single phase induction motor – Double field revolving theory and operation – Equivalent circuit – No load and blocked rotor test – Performance analysis – Starting methods of single-phase induction motors – Capacitor-start capacitor run Induction motor-Shaded pole induction motor

UNIT V Special Machines (8 Hours)

Linear induction motorRepulsion motor – Hysteresis motor – AC series motor – introduction to magnetic levitation systems – permanent magnet brushless DC motors - switched reluctance motors - Servo motors- Stepper motors

Text/References:

1. A. E. Fitzgerald and C. Kingsley, "Electric Machinery", McGraw Hill Education, 2013.
2. M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.
3. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.
4. I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.
5. A. S. Langsdorf, "Alternating current machines", McGraw Hill Education, 1984.
6. P. C. Sen, "Principles of Electric Machines and Power Electronics", John Wiley & Sons, 2007.

BEE-403 ELECTROMAGNETIC THEORY (L-T-P-C: 3-1-0-4)

Unit 1: Review of Vector Calculus (8 Hours)
Vector algebra-addition, subtraction, components of vectors, scalar and vector multiplications, triple products, three orthogonal coordinate systems (rectangular, cylindrical and spherical). Vector calculus-differentiation, partial differentiation, integration, vector operator del, gradient, divergence and curl; integral theorems of vectors. Conversion of a vector from one coordinate system to another

Unit 2: Static Electric Field (8 Hours)
Coulomb's law, Electric field intensity, Electrical field due to point charges. Line, Surface and Volume charge distributions. Gauss law and its applications, Absolute Electric potential, Potential difference, Calculation of potential differences for different configurations, Electric dipole, Electrostatic Energy and Energy density
Conductors, Dielectrics and Capacitance Current and current density, Ohms Law in Point form, Continuity of current, Boundary conditions of perfect dielectric materials. Permittivity of dielectric materials, Capacitance Capacitance of a two wire line

Unit 3: Static Magnetic Fields (8 Hours)
Biot-Savart Law, Ampere Law, Magnetic flux and magnetic flux density, Scalar and Vector Magnetic potentials. Steady magnetic fields produced by current carrying conductors.
Magnetic Forces, Materials and Inductance (6 Hours) Force on a moving charge, Force on a differential current element, Force between differential current elements, Nature of magnetic materials, Magnetization and permeability, Magnetic boundary conditions, Magnetic circuits, inductances and mutual inductances.

Unit 4: Time Varying Fields and Maxwell's Equations (8 Hours)
Faraday's law for Electromagnetic induction, Displacement current, Point form of Maxwell's equation, Integral form of Maxwell's equations, Motional Electromotive forces, Boundary Conditions

Unit 5: Electromagnetic Waves (8 Hours)
Derivation of Wave Equation, Uniform Plane Waves, Maxwell's equation in Phasor form, Wave equation in Phasor form, Plane waves in free space and in a homogenous material. Wave equation for a conducting medium, Plane waves in lossy dielectrics, Propagation in good conductors, Skin effect. Poynting theorem.

Text / References:

1. M. N. O. Sadiku, "Elements of Electromagnetics", Oxford University Publication, 2014.
2. W. Hayt, "Engineering Electromagnetics", McGraw Hill Education, 2012.
3. A. Pramanik, "Electromagnetism - Theory and applications", PHI Learning Pvt. Ltd, New Delhi, 2009.
4. A. Pramanik, "Electromagnetism-Problems with solution", Prentice Hall India, 2012.
5. G.W. Carter, "The electromagnetic field in its engineering aspects", Longmans, 1954.
   W.J. Duffin, "Electricity and Magnetism", McGraw Hill Publication, 1980.
6. W.J. Duffin, "Advanced Electricity and Magnetism", McGraw Hill, 1968.

7. E.G. Cullwick, “The Fundamentals of Electromagnetism”, Cambridge University Press, 1966.
8. B. D. Popovic, “Introductory Engineering Electromagnetics”, Addison-Wesley Educational Publishers, International Edition, 1971.

BCS-402 DATA STRUCTURES AND ALGORITHMS (L-T-P-C: 3-0-0-3)

Unit 1 (8 Hours)

Introduction: Basic concepts and notations, Mathematical background, Revision of arrays and pointers, Recursion and implementation of Recursion, Time and Space Complexity, Asymptotic notations: Big Oh, Big Theta and Big Omega, Time-Space trade-off.

Searching: linear search and binary search techniques.

Unit 2 (8 Hours)

Stacks and Queues: Sequential representation of stacks and queues, Primitive Stack operations: Push & Pop, Application of stack: Prefix and Postfix Expressions, Evaluation of postfix expression,conversion of infix to postfix.

Lists: List representation techniques, Dynamics Storage allocation, Representation of stacks and queues using linked list, Operations on a Linked List: Insertion, Deletion, Traversal, Introduction to Doubly linked list, introduction to circularly linked list.

Unit 3 (8 Hours)

Sorting Algorithms and hashing: Insertion sort, Bubble sort, Quick sort, Merge sort, Heap sort, Shell sort, Time and Space complexity of sorting algorithms, hashing.

Unit 4 (8 Hours)

Trees: Definition and basic concepts, Linked tree **r**epresentations, Binary tree traversal algorithms,(Preorder, Inorder, Postorder), Binary search tree, Insertion and Deletion in Binary search tree, Multiway search trees, B trees, B+ tree and their applications.

Unit 5 (8 Hours)

Graphs: Introduction to Graphs, Data Structure for Graph Representations: Adjacency Matrices, Adjacency List, Graph Traversal: Depth First Search and Breadth First Search, Shortest Path algorithm: Warshal Algorithm and Dijikstra Algorithm.

Text Books and References:

1. Y. Langsam, M.J. Augenstein and A.M. Tenenbaum, Data Structure Using C and C++. Second Edition, Prentice Hall of India, 1997.
2. Seymour Lipschutz, Data Structures , Schaum's Outlines, Tata McGraw Hill , New Delhi, 2006
3. Lafore – Data structure & Algorithms in java, (BPB Publication)
4. Sartaj Sahni – Data structure, Algorithms & application in C++ (McGraw Hill)

MC 301/ MC 401 ENVIRONMENT AND ECOLOGY (L-T-P-C: 2-0-0-0)

UNIT-I: Nature of Environment Introduction to Environmental Science - Definition and scope and need for public awareness Ecosystems Concept, structure and functions, restoration of damaged ecosystems Biodiversity – Definition, description at national and global level, threats and conservation Natural Resources - Renewable and non-renewable and their equitable use for sustainability, Material cycles – carbon, nitrogen and sulphur cycle. Conventional and Non-conventional Energy Sources – fossil fuel-based, hydroelectric, wind, -nuclear and solar energy, biomass, biodiesel, hydrogen as an alternative fuel

UNIT-II: Impact of Human Activity on Environment Human Population and Environment – Population growth, population explosion and migration; Impact of farming, housing, mining, transportation and industrial growth Social Issues Related to Environment– Sustainable development, urban problems (related to water and energy conservation and waste management), resettlement and rehabilitation Environmental ethics

UNIT-III: Environmental Changes and Human Health Environmental Pollution–Definition, causes and effects, control measures for water, air, soil, marine, land, noise, thermal pollution, Climate change– Greenhouse effect and global warming, acid rain, ozone layer formation and depletion Impact on human health – water and air borne diseases, diseases induced by residual impurities in drinking water (fluoride and arsenic); Toxic wastes and carcinogens; Nuclear hazards

UNIT- IV: Environmental Protection through Assessment and Education Indicators and Impact Assessment – Bio-indicators, Natural disasters and disaster management, Impact assessment through inventorying and monitoring Environmental Protection– Role of individuals, organizations and government in pollution control Laws, Conventions and Treaties–National legislation, issues in the enforcement of environmental legislation, initiatives by non-governmental organizations, global efforts in environmental protection Environmental education–women and value education Recommended

Textbook: Environmental Studies, J Krishnawamy , R J Ranjit Daniels, Wiley India.
Recommended Reference Books:

1. Environmental Science, Bernard J. Nebel, Richard T. Right, 9780132854467, Prentice Hall Professional 1993.
2. Environment and Ecology, R K Khandal, 978-81-265-4277-2, Wiley India.
3. Environmental Science, 8th Ed ISV, Botkin and Keller, 9788126534142, Wiley India.
4. Environmental Studies, R Rajagopalan, 978-0195673937, Oxford University Press
5. Textbook of Environmental Science and Technology, M.Anjireddy, BS Publications
6. Environmental Studies, Soli. J Arceivala, Shyam, R Asolekar, 9781259006050, McGrawHill India, 2012.
7. Environmental Studies, D.L. Manjunath, 9788131709122 Pearson Education India, 2007
8. Textbook of Environment Ecology, Singh, Acme Learning

9. Perspective in Environmental Studies, Kaushik, New Age International
10. Environmental Studies, B. Joseph, 2nd Ed, 978-0070648134, Tata McGraw Hill

BEE-451 MEASUREMENTS AND INSTRUMENS LAB (L-T-P-C: 0-0-2-1)

List of Experiments:

1. Study & observe the characteristics of Load Cell Sensor.
2. Study & observe the characteristics of LVDT.
3. Study & observe the characteristics of RTD Sensor.
4. Study & observe the characteristics of NTC Temperature Sensor.
5. Study & observe the characteristics of Temperature LM35 Sensor.
6. Study & observe the characteristics of Photovoltaic Cell.
7. Study & observe the characteristics of Photoconductive Cell.
8. Study & observe the characteristics of Photo Transistor.
9. Study & observe the characteristics of Photo Diode.
10. Study & observe the characteristics of Strain Gauge Sensor.
11. Study & observe the characteristics of IR Sensor.
12. Study & observe the characteristics of Ultrasonic Sensor.
13. Study & observe the characteristics of Smoke Sensor.
14. Study & observe the application of FPGA Trainer Kit.

BEC-454 LINEAR INTEGRATED CIRCUITS LAB (L-T-P-C: 0-0-2-1)

List of Experiments:

1. To design and implement an inverting amplifier circuit.
2. To design and implement a non-inverting amplifier circuit.
3. To design and implement a voltage follower circuit.
4. To design and implement a summing amplifier circuit.
5. To design and implement a difference amplifier circuit
6. To design and implement a Differentiator circuit
7. To design and implement an integrator circuit
8. To design and implement an Instrumentation Amplifier circuit
9. To design and implement Precision Rectifier circuit implement
10. To design and implement RC oscillator.
11. To design and implement LC oscillator.
12. To implement monostable, bistable, astable multivibrators using Opamp 741.
13. To implement Phase Locked Loop.
14. To implement Frequency Multiplier.
15. To implement A/D Converters & D/A Converters.
16. To implement Second Order Active Filter- High Pass & Low Pass Realization.

BEE-452 ELECTRICAL MACHINES LAB –II (L-T-P-C: 0-0-2-1)

1. No Load and Blocked Rotor Test on a 3- ϕ Induction Motor
2. Equivalent Circuit of a Single-Phase Induction Motor
3. Brake Test on 3- ϕ Squirrel Cage Induction Motor
4. Starting of Slip Ring Induction Motor by Rotor Resistance Method
5. Star-Delta Starter
6. Determination of X_d And X_q of Salient Pole Synchronous Motor
7. V' and 'Inverted V' Curves of Synchronous Motor
8. Voltage Regulation of Alternator by synchronous Impedance Method
9. Sumpner's Test on a Transformer
10. Scott Connection of Transformers
11. Parallel Operation of Transformers
12. Separation of Hysteresis and Eddy Current Losses in a Transformer
13. Brushless DC Motor – Load Characteristics and speed control
14. Single phase Induction motor

BCS-452 DATA STRUCTURES AND ALGORITHMS LAB (L-T-P-C: 0-0-2-1)

Course Detail: Write Program in C / C++ for following:

1. To implement stack using array
2. To implement queue using array
3. To implement circular queue using array
4. To implement various operations on linked list:

   (a)insert (b)delete (c) display
5. To implement stack using linked list
6. To implement queue using linked list
7. To implement linear search
8. To implement binary search
9. To implement bubble sort
10. To implement insertion sort
11. To implement merge sort
12. To implement quick sort
13. Program to find the factorial of a number using recursion
14. To implement Heap sort
15. Implementation of graph menu driven program

V SEMSTER

BEE-501	Power Systems – I	L-T-P-C: 3-0-0-3
Course Outcomes: At the end of this course students will demonstrate the ability to		
CO1	Understand the concepts of power systems	
CO2	Distinguish between various components of power system	
CO3	To analyse different types of faults, Estimate fault currents, over-voltages and insulation coordination	
CO4	Comprehend basic protection schemes	
CO5	Understand concepts of HVDC power transmission and renewable energy generation	

Unit – 1: **Basic Concepts (5 hours)**

Evolution of Power Systems and Present-Day Scenario - Structure of a power system: Bulk Power Grids and Micro-grids. Transmission and Distribution Systems: Line diagrams, transmission and distribution voltage levels and topologies (meshed and radial systems). Feeder, Service mains Substations, Mechanical design of Transmission, Synchronous Grids and Asynchronous (DC) interconnections - Comparison of ac and dc transmission

Unit – 2: Power System Analysis (10 hours)

Overhead Transmission Lines and Cables: Electrical and Magnetic Fields around conductors, Corona. Parameters of lines and cables - Capacitance and Inductance calculations for simple configurations - Short, medium and long lines - Power Transfer, Voltage profile and Reactive Power - Characteristics of transmission lines - Surge Impedance Loading - Generation of Over-voltages: Lightning and Switching Surges - Protection against Over voltages, Insulation Coordination. Propagation of Surges - Voltages produced by traveling surges - Bewley Diagrams

Unit – 3: Power System Components (10 hours)

Insulators, Application of Phase-shifts - Distribution transformers, Tap-Changing transformers. Synchronous Machines: Steady-state performance characteristics. Real and Reactive Power Capability Curve of generators - Typical waveform under balanced terminal short circuit conditions – steady state, transient and sub-transient equivalent circuits. Loads: Types, Voltage and Frequency Dependence of Loads. Per-unit System and per-unit calculations

Unit – 4: Fault Analysis and Protection Systems (10 hours)

Method of Symmetrical Components (positive, negative and zero sequences) - Balanced and Unbalanced Faults - Representation of generators, lines and transformers in sequence networks - Computation of Fault Currents - Neutral Grounding

Switchgear: Types of Circuit Breakers - Attributes of Protection schemes, Back-up Protection - Protection schemes (Over-current, directional, distance protection, differential protection) and their application

Unit – 5: Introduction to DC Transmission (5 hours)

DC Transmission Systems: Line-Commutated Converters (LCC) and Voltage Source Converters (VSC). LCC and VSC based dc link, Real Power Flow control in a dc link - Comparison of ac and dc transmission

Text/References:

1. J. Grainger and W. D. Stevenson, “Power System Analysis”, McGraw Hill Education, 1994.

2. O. I. Elgerd, “Electric Energy Systems Theory”, McGraw Hill Education, 1995.

3. A. R. Bergen and V. Vittal, “Power System Analysis”, Pearson Education Inc., 1999

4. D. P. Kothari and I. J. Nagrath, “Modern Power System Analysis”, McGraw Hill Education, 2003.

5. B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, “Electric Power Systems”, Wiley, 2012.

BEE-502	Signals and Systems	L-T-P-C: 2-0-0-2
Course Outcomes: At the end of this course students will demonstrate the ability to		
CO1	Analyse different types of signals	
CO2	Represent continuous and discrete systems in time and frequency domain using different transforms	
CO3	Investigate whether the system is stable	
CO4	Do Sampling and reconstruction of a signal	

Course Details:

Unit – I: Introduction to Signals and Systems (3 hours)

Signals and systems as seen in everyday life, and in various branches of engineering and science - Signal properties: periodicity, absolute integrability, determinism and stochastic character - Some special signals of importance: the unit step, the unit impulse, the sinusoid, the complex exponential, some special time-limited signals; continuous and discrete time signals, continuous and discrete amplitude signals. System properties: linearity: additivity and homogeneity, shift-invariance, causality, stability, realizability – Examples

Unit – II: Behaviour of continuous and discrete-time LTI systems (8 hours)

Impulse response and step response, convolution, input-output behavior with aperiodic convergent inputs, cascade interconnections - Characterization of causality and stability of LTI systems - System representation through differential equations and difference equations- State-space Representation of systems- State-Space Analysis, Multi-input, multi-output representation - State Transition Matrix and its Role - Periodic inputs to an LTI system, the notion of a frequency response and its relation to the impulse response.

Unit – III: Fourier Transforms (5 hours)

Fourier series representation of periodic signals, Waveform Symmetries, Calculation of Fourier Coefficients. Fourier Transform, convolution/multiplication and their effect in the frequency domain, magnitude and phase response, Fourier domain duality. The Discrete-Time Fourier Transform (DTFT) and the Discrete Fourier Transform (DFT). Parseval's Theorem

Unit – IV: Laplace and Z-Transforms (5 hours)

Review of the Laplace Transform for continuous time signals and systems, system functions, poles and zeros of system functions and signals, Laplace domain analysis, solution to differential equations and system behavior. The z-Transform for discrete time signals and systems, system functions, poles and zeros of systems and sequences, z-domain analysis

Unit – V: Sampling and Reconstruction (4 hours)

The Sampling Theorem and its implications - Spectra of sampled signals - Reconstruction: ideal interpolator, zero-order hold, first-order hold. Aliasing and its effects - Relation between continuous and discrete time systems- Introduction to the applications of signal and system theory: modulation for communication, filtering, feedback control systems.

Text Books:

1. Simon Haykins and Barry Van Veen, "Signals and Systems", 2nd Edition, Wiley India.

2. Charles Phillips, "Signals, Systems and Transforms", 3rd Edition, Pearson Education.

3. A.V.Oppenphim, A.S.Willsky and S.H.Nawab; signals and systems, prentice Hall.

4. B.P.Lathi, Signal and sysytem, Oxford university press , New Delhi.

Reference Books:

1. M.J. Roberts "Signal and Systems", Tata McGraw Hill 2007.

2. ShailaApte, "Signals and Systems-principles and applications", Cambridge University press, 2016.

3. MrinalMandal and Amir Asif, Continuous and Discrete Time Signals and Systems, Cambridge University Press, 2007.

4. Peyton Peebles, "Probability, Random Variable, Random Processes", 4th Edition, Tata McGraw Hill.

5. A. NagoorKanni "Signals and Systems", 2nd edition, McGraw Hill.

6. NPTEL video lectures on Signals and Systems

BEE-503	Microprocessors and Microcontrollers	L-T-P-C: 3-0-0-3
CO1	1. Recall and apply a basic concept of digital fundamentals to microprocessor based personal computer system and Recall the memory types and understand the interfacing of memory with microprocessor. 2. Understand the internal architecture and organization of 8085 & 8086.	
CO2	1. Apply knowledge and demonstrate programming proficiency using the various addressing modes and data transfer instructions of the target microprocessor and microcontroller. 2. Analyse assembly language programs; select appropriate assemble into machine a cross assembler utility of a microprocessor and microcontroller.	
CO3	Discuss how the different peripherals are interfaced with microprocessor like 8255,8253/54,8237,8279 etc.	
CO4	1. To analyse the concepts of memory interfacing for faster execution of instructions and improves the speed of operations & hence performance of microprocessors. 2.To Understand the basic knowledge of advanced processor and analyse the internal architecture of 80286,80486 and Pentium processor.	
C05	1. Analyse the internal architecture and real time control of 8051. 2. Analyse the internal architecture of ARM Processors.	

Unit-I

Introduction to Microprocessor:

Evolution of Microprocessors, Register structure, ALU, Bus Organization, Timing and Control.

8-bit microprocessor: 8085 Microprocessor and its Architecture, Addressing Modes, The 8085 Programming Model, Instruction Classification, Instruction Format, Overview of Instruction set- Data Transfer Operation, Arithmetic Operation, Logic Operation and Branch Operation; Introduction to Assembly language program., Assembler Directives, Parameter passing and recursive procedures.

Unit-II

Programming Technique With Additional Instruction: Looping, Counting, Indexing, Additional data Transfer and 16 bit Arithmetic instruction, Counters and time delays, Stack and Subroutine

16 bit Microprocessor: Architecture of 8086- Register Organization, Execution unit, Bus Interface Unit, Signal Description, Physical Memory Organization, Mode of Operation, I/O Addressing Capabilities.

Features of Numeric processor 8087,Floating point representation, range resolution, normalization, representation of zero, unused codes, parity bit and error detection.

Unit- III

Basic of Interfacing:

Programmed I/O, Interrupt driven I/O, DMA(8257), Parallel I/O (8255-PPI), Serial I/O(8251/8250, RS-232 standard)

8259 Programmable Interrupt Controller, 8237-DMA Controller, 8253/8254 Programmable Timer/Counter,(8279) Keyboard and display interface, ADC and DAC interfacing

Unit- IV

Memory Interfacing:

Types of memory, RAM and ROM , Concepts of virtual memory, Cache memory. Advanced coprocessor Architecture-286,486, pentium

Unit-V

An Introduction to Microcontroller 8051 : The 8051 Architecture, Instruction set,Basic Assembly language programming concept.

Introduction to Risc Processor: ARM microcontrollers Interface design

Textooks:

1. Douglas V.Hall/8086 Microprocessors Architecture
2. R.S. Gaonker/Microprocessor Architecture: Programming and Applications with the 8085/8080A/ Penram Interational Publishing,1996.
3. Kenneth J.Ayala/The 8051 Microcontroller/Penram International Publishing.

References:

4. Liu Gibson/Microprocessor
5. Ray, A.K. & Burchandi, K.M./ "Advanced Microprocessors and Peripherals: Architecture, Programming and Interfacing"/ Tata McGraw Hill.
6. Brey, Barry B. / "INTEL microprocessors" / Prentice Hall (India) /4th Ed.

BHSM-501	Economics for Industry	L-T-P-C: 3-0-0-3

Economics for Industry – Common Syllabus

BEE-551	Power System Laboratory -I	L-T-P-C: 0-0-2-1

1.To determine direct axis reactance (xd) and quadrature axis reactance (xq) of a salient pole alternator.

2. To determine negative and zero sequence reactances of an alternator.

3. To determine sub transient direct axis reactance (xd) and sub transient quadrature axis reactance (xq) of an alternator

4. To determine fault current for L-G, L-L, L-L-G and L-L-L faults at the terminals of an alternator at very low excitation

5. To study the IDMT over current relay and determine the time current characteristics 6. To study percentage differential relay

7. To study Impedance, MHO and Reactance type distance relays

8. To determine location of fault in a cable using cable fault locator

9. To study Ferranti effect and voltage distribution in H.V. long transmission line using transmission line model.

10. To study operation of oil testing set.

Simulation Based Experiments (using MATLAB or any other software)

11. To determine transmission line performance.

12. To obtain steady state, transient and sub-transient short circuit currents in an alternator

13. To obtain formation of Y-bus and perform load flow analysis

14. To perform symmetrical fault analysis in a power system

15. To perform unsymmetrical fault analysis in a power system

Text Books:-

1. Hasdi Sadat, “Power System Analysis” Tata Mc.Graw Hill.

2. T. K. Nagsarskar & M.S. Sukhija,’ Power System Analysis’ Oxford Universitry Press.

Note: - At least 10 experiments should be performed out of which 3 should be simulation based.

BEE-553	Microprocessor Laboratory	L-T-P-C: 0-0-2-1

Study Experiments

1. To study 8085 based microprocessor system

2. To study 8086 and 8086A based microprocessor system

3. To study Pentium Processor

B. Programming based Experiments (any four)

4. To develop and run a program for finding out the largest/smallest number from a given set of numbers.

5. To develop and run a program for arranging in ascending/descending order of a set of numbers

6. To perform multiplication/division of given numbers

7. To perform conversion of temperature from 0 F to 0 C and vice-versa

8. To perform computation of square root of a given number

9. To perform floating point mathematical operations (addition, subtraction, multiplication and division)

C. Interfacing based Experiments (any four)

10. To obtain interfacing of RAM chip to 8085/8086 based system

11. To obtain interfacing of keyboard controller

12. To obtain interfacing of DMA controller

13. To obtain interfacing of PPI

14. To obtain interfacing of UART/USART

15. To perform microprocessor based stepper motor operation through 8085 kit

16. To perform microprocessor based traffic light control

17. To perform microprocessor based temperature control of hot water.

BEE-552	Electronics Design Lab	L-T-P-C: 0-0-2-1

Note: Minimum ten experiments are to be performed from the following list: VSM Proteus / e-sim may be used.

Experiment List:

1. General Instructions about PCB Design
2. Simulation of UJT operation
3. To study and plot the characteristics of an LED
4. To study and plot the characteristics of an LDR
5. To study and plot the characteristics of a Photo-voltatic cell
6. To study and design an Opto-coupler
7. To study and plot the characteristics of a Photo diode
8. To study and plot the characteristics of a Solar cell
9. To prepare design layout of PCBs using software tools.
10. To fabricate PCB and test an electronic circuit on PCB
11. PCB Design of a Full Wave Rectifier
12. PCB Design of a Regulated Power Supply
13. To design and test regulated power supply using ICs
14. To study the specifications and working of a VCD Player.
15. To study the specifications and working of color TV.

VI SEMESTER

BEE-601	Power Systems – II	L-T-P-C: 3-1-0-4
Course Outcomes: At the end of this course students will demonstrate the ability to		
CO1	Apply numerical methods to analyse a power system in steady state	
CO2	Comprehend stability constraints in a synchronous grid	
CO3	Understand methods to control the voltage, frequency and power flow	
CO4	Comprehend the monitoring and control of a power system	
CO5	Appreciate the basics of power system economics	

UNIT-I: Power Flow Analysis

Analysis of Power Flows: Formation of Bus Admittance Matrix. Real and reactive power balance equations at a node. Load and Generator Specifications Application of numerical methods for solution of nonlinear algebraic equations – Gauss Seidel and Newton-Raphson methods for the solution of the power flow equations - Computational Issues in Large-scale Power Systems

UNIT-II: Stability Constraints in synchronous grids (8 hours)

Swing Equations of a synchronous machine connected to an infinite bus - Loss of synchronism due to Three--phase fault - Analysis using numerical integration of swing equations (Forward Euler, Runge-Kutta 4th order methods) - Equal Area Criterion. Impact of stability constraints on Power System Operation- Effect of generation rescheduling and series compensation of transmission lines on stability

UNIT-III: Load Frequency Control

Control of Frequency and Voltage: Turbines and Speed-Governors, Frequency dependence of loads, Droop Control and Power Sharing - Automatic Generation Control.

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UNIT-IV: Monitoring Power System And Excitation Control

Overview of Energy Control Centre Functions: SCADA systems and its components, protocol - Phasor Measurement Units - and Wide-Area Measurement Systems. Normal, Alert, Emergency, Extremis states of a Power System.

Excitation System Control in synchronous generators, Automatic Voltage Regulators. Shunt Compensators, Static VAR compensators and STATCOMs - Tap Changing Transformers. Three phase Induction regulators, Voltage Stability, Voltage Collapse.

UNIT-V: Basic Pricing Principles

Generator Cost Curves, Vertically Integrated Utility and restructured Power System - Role of Different entities in restructured market - Market clearing price, Single sided and double sided linear bid market - Transmission and Distributions charges

Text/References:

1. J. Grainger and W. D. Stevenson, “Power System Analysis”, McGraw Hill Education, 1994.
2. O. I. Elgerd, “Electric Energy Systems Theory”, McGraw Hill Education, 1995.
3. A. R. Bergen and V. Vittal, “Power System Analysis”, Pearson Education Inc., 1999.

4. D. P. Kothari and I. J. Nagrath, “Modern Power System Analysis”, McGraw Hill Education, 2003.
5. B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, “Electric Power Systems”, Wiley, 2012.

BEE-602	Automatic Control System	L-T-P-C: 3-1-0-4
CO1	Understand concepts of Time Domain and Frequency Domain Analysis	
CO2	Model linear-time-invariant systems using transfer function	
CO3	Model linear-time-invariant systems using state-space representations	
CO4	Apply the concept of stability in linear-time invariant systems	
C05	Design simple feedback controllers	

UNIT I

Control System And Their Representation: Terminology and basic structure of control system, Open loop and Closed loop systems, analogous systems. Physical Systems and their models, Electromechanical systems, electrical analogy of physical systems. Transfer function, Block diagram representation of physical systems, Block diagram algebra, Signal Flow graph and Mason's formula.

UNIT II

Time Response: Types of test inputs, Response of first and second order system, Time domain specifications, Static and Dynamic Error coefficients.

UNIT III

Frequency Domain Analysis: Concepts of Gain margin and phase margin, Bode plots Frequency-domain specifications, Polar plots, Inverse Polar Plots, M-N circle.

UNIT IV

Stability Theory: Routh Hurwitz Stability Criterion, Root locus plot, Properties of Root loci and applications, Stability range from the loci. Determination of roots of the closed loop system, Effect of pole zero addition, Nyquist stability criterion.

UNIT V

Controllers: Introduction to PID and Lag-lead type Controllers

State Variable Analysis: Concepts of state, state variable and state model. State variable models for LTI systems. Canonical representations, Transfer function to state-space and vice-versa. Solution to state equations. Concepts of controllability & observability.

Compensation Design: compensation design using frequency domain techniques

Text book:

1. KUO B.CI Automatic control system/Pill.
2. Ogata Kj Modern Control Engineering / PHI.
3. Nagrath I.J. & Gopal, M/Control Systems Engineering/New Age International.
4. S.N. Sivanandam/Control Systems Engineering /Vikas Publishing House Pvt. Ltd.

References:

1. Singh & Janardhanan - Modern control engineering, Cengage learning
2. Control Systems,Srivastava,TMH 2009
3. Systems and Control - Stanislawhizak, Oxford
4. Control System Engineering,S. K. Bhattacharya,Pearson
5. Control Systems: Theory And Applications,Ghosh,Pearson

BEE-603	Power Electronics	L-T-P-C: 3-1-0-4
Course Outcomes: At the end of this course students will demonstrate the ability to		
CO1	Ability to analyse different types of power semiconductor devices and their switching.	
CO2	Demonstrate the triggering circuit and snubber circuit, operation of choppers and basic topologies of DC-DC Switching regulators	
CO3	Ability to analyse operation, characteristics and performance parameter of controlled rectifiers	
CO4	Illustrate the operation of AC voltage controller and cyclo- converter and its application.	
C05	Analyse the operation of single phase and three phase inverters with and without PWM techniques and to understand harmonic reduction methods.	

UNIT-I

Power Semiconductor Devices: Diode, Thyristors, BJT, Power MOSFET and Power IGBT and their characteristics. Firing Circuit for Thyristor - Two transistor analogy of SCR, Series and parallel connections of SCR's - Thyristor Commutation Technique - Gate drive Circuits for MOSFET and IGBT. GTO, MCT and TRIAC

UNIT-II

Single phase half wave controlled, rectifier with resistive and inductive loads, effect of freewheeling diode. Single phase fully controlled and half controlled bridge converters -

Three phase half wave converters, Three phase fully controlled and half controlled bridge converters, Effect of source impedance, Single phase and three phase dual converters -

Resonant converters

UNIT-III

Choppers: Time ratio control and Current limit control strategies Step down choppers-Derivation of load voltage and currents with R, RL and RLE loads-Step up Chopper load voltage expression. Morgan's chopper Jones chopper Oscillation choppers (Principle of operation only) - waveforms AC Chopper Problems.

UNIT-IV

Principle of On-Off and phase controls, Single phase ac voltage controller with resistive and inductive loads - Three phase ac voltage controllers (various configurations and comparison), Single phase transformer tap changer

Cyclo-Converters, Basic principle of operation, single phase to single phase, three phase to single phase and three phase to three phase cyclo-converters, output voltage equation

UNIT-V

Single-phase voltage source inverter: Power circuit of single-phase voltage source inverter, switch states and instantaneous output voltage, square wave operation of the inverter, concept of average voltage over a switching cycle, bipolar sinusoidal modulation and unipolar sinusoidal modulation, modulation index and output voltage

Three-phase voltage source inverter: Power circuit of a three-phase voltage source inverter, switch states, instantaneous output voltages, average output voltages over a sub-cycle, three-phase sinusoidal modulation - Harmonics reduction techniques, Single phase and three phase current source inverters

Text Books

1. P.S.Bhimbra, "Power Electronics",Khanna publications.
2. M.D.Singh & K.B.Kanchandhani, Power Electronics, Tata McGrawHill Publishing company, 1998.

Reference Books

1. Vedam Subramanyam, Power Electronicsby New Age International (P) Limited, Publishers
2. P.C.Sen, Power Electronics, Tata McGraw-Hill Publishing.

BEE-651	Power Systems Lab -II	L-T-P-C: 0-0-2-1

Note: Minimum ten experiments are to be performed from the following list

1. Calculate the parameters of single phase transmission line
2. Calculate the parameters of three phase single circuit transmission line
3. Calculate the parameters of three phase double circuit transmission line
4. Determine the ABCD constant for transmission line.
5. Simulate the Ferranti effect in transmission line
6. Calculate the corona loss of transmission line
7. Calculation of sag & tension of transmission line
8. Calculation of string efficiency of insulator of transmission line
9. Calculation for grading of underground cables
10. Simulate the skin effect in the transmission line
11. Calculation of ground clearance of transmission line
12. Calculate the parameters for underground cable

BEE-652	Control System Laboratory	L-T-P-C: 0-0-2-1

Note: The minimum of 10 experiments are to be performed from the following, out of which at least three should be software based.

1. To study P, PI and PID temperature controller for an oven and compare their performance.

2. To study and calibrate temperature using resistance temperature detector (RTD)

4. To design Lag, Lead and Lag-Lead compensators using Bode plot.

5. To study DC position control system

6. To study synchro-transmitter and receiver and obtain output vs input characteristics

7. To determine speed-torque characteristics of an ac servomotor.

8. To study performance of servo voltage stabilizer at various loads using load bank.

9. To study behavior of separately excited dc motor in open loop and closed loop conditions at various loads.

Software based experiments (Use MATLAB, LABVIEW software etc.)

10. To simulate PID controller for transportation lag.

11. To determine time domain response of a second order system for step input and obtain performance parameters.

12. To convert transfer function of a system into state space form and vice-versa.

13. To plot root locus diagram of an open loop transfer function and determine range of gain 'k' fir stability.

14. To plot a Bode diagram of an open loop transfer function.

15. To draw a Nyquist plot of an open loop transfers functions and examine the stability of the closed loop system.

Reference Books:

1. K.Ogata,"Modern Control Engineering" Prentice Hall of India.

2. Norman S.Nise, "Control System Engineering", John Wiley & Sons.

3. M.Gopal, "Control Systems: Principles & Design" Tata Mc Graw Hill

BEE-653	Power Electronics and Drives Laboratory	L-T-P-C: 0-0-2-1

Note: The minimum of 10 experiments is to be performed out of which at least three should be software based.

1. To study V-I characteristics of SCR and measure latching and holding currents.

2. To study UJT trigger circuit for half wave and full wave control.

3. To study single-phase half wave controlled rectified with (i) resistive load (ii) inductive load with and without free wheeling diode.

4. To study single phase (i) fully controlled (ii) half controlled bridge rectifiers with resistive and inductive loads.

5. To study three-phase fully/half controlled bridge rectifier with resistive and inductive loads.

6. To study single-phase ac voltage regulator with resistive and inductive loads. 7. To study single phase cyclo-converter

8. To study triggering of (i) IGBT (ii) MOSFET (iii) power transistor

9. To study operation of IGBT/MOSFET chopper circuit

10. To study MOSFET/IGBT based single-phase series-resonant inverter.

11. To study MOSFET/IGBT based single-phase bridge inverter. Software based experiments(PSPICE/MATLAB)

12. To obtain simulation of SCR and GTO thyristor.

13. To obtain simulation of Power Transistor and IGBT.

14. To obtain simulation of single phase fully controlled bridge rectifier and draw load voltage and load current waveform for inductive load.

15. To obtain simulation of single phase full wave ac voltage controller and draw load voltage and load current waveforms for inductive load.

16. To obtain simulation of step down dc chopper with L-C output filter for inductive load and determine steady-state values of output voltage ripples in output voltage and load current.

Text/Reference Books:

1. M.H.Rashid, “Power Electronics: Circuits, Devices and Applications”, 3 rd Edition, prentice Hall of India.

2. D.W. Hart, “Introduction to power Electronics” Prentice hall Inc.

3. Randal Shaffer, “Fundamentals of Power Electronics with MATLAB” Firewall Media,

VII SEMESTER

BEE-701	Digital Signal Processing	L-T-P-C: 3-0-0-3
Course Outcomes: At the end of this course students will demonstrate the ability to		
CO1	Represent signals mathematically in continuous and discrete-time, and in the frequency domain.	
CO2	Understand the Discrete-Fourier Transform (DFT) and the FFT algorithms	
CO3	Realize Digital filter structures	
CO4	Design digital filters for various applications	
C05	Apply multi-rate digital signal processing for the analysis of real-life signals including image	

UNIT-I SIGNALS AND SIGNAL PROCESSING:

Characterization & classification of signals, typical Signal Processing operations, example of typical Signals, typical Signals Processing applications, discrete time random signals- Discrete Time Signals, Operations on Sequences, the sampling process, Discrete-Time systems, Time-Domain characterization of LTI Discrete-Time systems, Correlation of signals.

UNIT-II TRANSFORM-DOMAIN REPRESENTATION OF SIGNALS:

Discrete-Time Fourier Transform, Discrete Fourier Transform, DFT properties, computation of the DFT of real sequences, Linear Convolution using the DFT. FFT Algorithms.

DIGITAL PROCESSING OF CONTINUOUS-TIME SIGNALS:

Sampling of Continuous Signals, Analog Filter Design, Anti-aliasing Filter Design, Sample-and-hold circuits, A/ D & D/ A converter, Reconstruction Filter Design

UNIT-III DIGITAL FILTER STRUCTURE:

Block Diagram representation, Signal Flow Graph Representation, Equivalent Structures, FIR Digital Filter Structures, IIR Filter Structures, Parallel all pass realization of IIR transfer function, Digital Sine-Cosine generator.

UNIT-III: DIGITAL FILTER DESIGN:

Impulse invariance method of IIR filter design, Bilinear Transform method of IIR Filter Design, Design of Digital IIR notch filters, FIR filter Design based on truncated fonner sens, FIR filter design based on Frequency Sampling approach - Applications of DSP

UNIT-V MULTIRATE DIGITAL SIGNAL PROCESSING:

Introduction to multi-rate digital signal processing, sampling rate conversion, filter structures, multistage decimator and interpolators, digital filter banks.

DIGITAL IMAGE PROCESSING: Digital Image Representation, Fundamental Steps in Image Processing, Elements of Digital image processing systems.

TEXT Text / Reference Books:

1. S. K. Mitra, “Digital Signal Processing: A computer based approach”, McGraw Hill, 2011.

2. A.V. Oppenheim and R. W. Schafer, “Discrete Time Signal Processing”, Prentice Hall, 1989.

3. J. G. Proakis and D.G. Manolakis, “Digital Signal Processing: Principles, Algorithms And Applications”, Prentice Hall, 1997.

4. L. R. Rabiner and B. Gold, “Theory and Application of Digital Signal Processing”, Prentice Hall, 1992.

5. J. R. Johnson, “Introduction to Digital Signal Processing”, Prentice Hall, 1992.

6. Digital Signal Processing : Salivahanan & Gnanapriya; TMH Pub.

BEE-702	Advanced Electrical Drives	L-T-P-C: 2-0-0-2
Course Outcomes: At the end of this course students will demonstrate the ability to		
CO1	To comprehend the fundamentals of Electric Drives	
CO2	To understand the dynamics of Electric Drive	
CO3	To comprehend the dynamics of starting and braking of DC, Three phase Induction and Synchronous motors	
CO4	Understand the power electronic converters used for dc motor speed control	
CO5	Understand the power electronic converters used for induction motor speed control	

UNIT-I: Fundamentals of Electric Drive

Electric Drives and its parts, advantages of electric drives Classification of electric drives Speed-torque conventions and multi-quadrant operations Constant torque and constant power operation Types of load torque: components, nature and classification

UNIT-II: Dynamics of Electric Drive

Dynamics of motor-load combination Steady state stability of Electric Drive Transient stability of electric Drive Selection of Motor Power rating: Thermal model of motor for heating and cooling, classes of motor duty, determination of motor power rating for continuous duty, short time duty and intermittent duty. Load equalization

UNIT-III: Electric Braking

Purpose and types of electric braking, braking of DC, Three phase Induction and Synchronous motors - Dynamics during Starting and Braking: Calculation of acceleration time and energy loss during starting of DC shunt and three phase induction motors, methods of reducing energy loss during starting. Energy relations during braking, dynamics during braking

UNIT-IV: Power Electronic Control of DC Drives

Single phase and three phase controlled converter fed separately excited DC motor drives (continuous conduction only), dual converter fed separately excited DC motor drive, rectifier control of DC series motor. Supply harmonics, power factor and ripples in motor current Chopper control of separately excited DC motor and DC series motor.

UNIT-V: Power Electronic Control of AC Drives

Three Phase induction Motor Drive: Static Voltage control scheme, static frequency control scheme (VSI, CSI, and cyclo – converter based) static rotor resistance and slip power recovery control schemes. Three Phase Synchronous motor: Self controlled scheme Special Drives: Switched Reluctance motor, Brushless dc motor. Selection of motor for particular applications

Text Books:

1. G.K. Dubey, “Fundamentals of Electric Drives”, Narosa publishing House.

2. S.K. Pillai, “A First Course on Electric Drives”, New Age International.

3. B.N. Sarkar, “Fundamental of Industrial Drives”, Prentice Hall of India Ltd.

Reference Books:

1 M. Chilkin, “Electric Drives”,Mir Publishers, Moscow.

2 Mohammed A. El-Sharkawi, “Fundamentals of Electric Drives”, Thomson Asia, Pvt. Ltd. Singapore.

3 N.K. De and Prashant K. Sen, “Electric Drives”, Prentice Hall of India Ltd.

4 V. Subrahmanyam, “Electric Drives: Concepts and Applications”, TataMcGraw Hill.

BEE-703	Power System Operation and Control	L-T-P-C: 3-0-0-3
Course Outcomes: At the end of this course students will demonstrate the ability to		
CO1	Comprehend structure of Power System	
CO2	Understand the economic operation of power system	
CO3	Describe Load Frequency Control methods	
CO4	Explain Automatic Voltage Control methods	
CO5	Understand State Estimation	

UNIT-I: Introduction

Structure of power systems, Power system control center and real time computer control, SCADA system Level decomposition in power system Power system security Various operational stages of power system Power system voltage stability

UNIT-II: Economic Operation

Concept and problems of unit commitment Input-output characteristics of thermal and hydro-plants System constraints Optimal operation of thermal units without and with transmission losses, Penalty factor, incremental transmission loss, transmission loss formula (without derivation) Hydrothermal scheduling long and short terms Concept of optimal power flow

UNIT-III: Load Frequency Control

Concept of load frequency control, Load frequency control of single area system: Turbine speed governing system and modeling, block diagram representation of single area system, steady state analysis, dynamic response, control area concept, P-I control, load frequency control and economic dispatch control. Load frequency control of two area system: Tie line power modeling, block diagram representation of two area system, static and dynamic response

UNIT-IV: Automatic Voltage Control

Schematic diagram and block diagram representation, different types of Excitation systems & their controllers - Voltage and Reactive Power control: Concept of voltage control, methods of voltage control- control by tap changing transformer. Shunt Compensation, series compensation, phase angle compensation

UNIT-V: State Estimation

Detection and identification, Linear and non-linear models - Flexible AC Transmission Systems: Concept and objectives FACTs controllers: Structures & Characteristics of following FACTs Controllers. TCR,FC-TCR, TSC, SVC, STATCOM, TSSC, TCSC, SSSC, TC-PAR, UPFC

Text Books:

1. D.P. Kothari & I.J. Nagrath, “Modern Power System Analysis” Tata Mc Graw Hill, 3rd Edition.

2. P.S.R. Murty, “Operation and control in Power Systems” B.S. Publications.

3. N. G. Hingorani & L. Gyugyi, “ Understanding FACTs” Concepts and Technology of Flexible AC Transmission Systems”

4. A. J. Wood & B.F. Wollenburg, “ Power Generation, Operation and Control “ John Wiley & Sons.

Reference Books:

1. O.I. Elgerd, “Electric Energy System Theory” Tata McGraw Hill.

2. P. Kundur, “ Power System Stability and Control Mc Graw Hill.

3. T. K. Nagsarkar & M.S. Sukhiza,’ Power System Analysis’ Oxford University Press.

BEE-751	Digital Signal Processing Lab	L-T-P-C: 0-0-2-1

Perform at least any 10 experiments (At least 5 from each section)

LIST OF EXPERIMENTS:

Perform the following experiments using MATLAB:

1. To represent basic signals (Unit step, unit impulse, ramp, exponential, sine and cosine).
2. To develop program for discrete convolution.
3. To develop program for discrete correlation.
4. To understand stability test.
5. To understand sampling theorem.
6. To design analog filter (low-pass, high pass, band-pass, band-stop).
7. To design digital IIR filters (low-pass, high pass, band-pass, band-stop).
8. To design FIR filters using windows technique.
9. To design a program to compare direct realization values of IIR digital filter
10. To develop a program for computing parallel realization values of IIR digital filter.
11. To develop a program for computing cascade realization values of IIR digital filter
12. To develop a program for computing inverse Z-transform of a rational transfer function

VIII SEMESTER

BEE-801	Industrial Electrical Systems	L-T-P-C: 2-0-0-2
Course Outcomes: At the end of this course students will demonstrate the ability to		
CO1	Understand various components of industrial electrical systems	
CO2	Understand the electrical wiring systems for residentialrepresenting the systems with standard symbols and drawings	
CO3	Analyse and choose the appropriate ratings of various electrical system components.	
CO4	Understand the electrical wiring systems of commercial and industrial consumers, representing the systems with standard symbols and drawings, SLD	
C05	To understand concepts of Automation and PLC SCADA	

UNIT I: Electrical System Components (8 Hours) LT system wiring components, selection of cables, wires, switches, distribution box, metering system, Tariff structure, protection components- Fuse, MCB, MCCB, ELCB, inverse current characteristics, symbols, single line diagram (SLD) of a wiring system, Contactor, Isolator, Relays, MPCB, Electric shock and Electrical safety practices

UNIT II: Residential and Commercial Electrical Systems (8 Hours) Types of residential and commercial wiring systems, general rules and guidelines for installation, load calculation and sizing of wire, rating of main switch, distribution board and protection devices, earthing system calculations, requirements of commercial installation, deciding lighting scheme and number of lamps, earthing of commercial installation, selection and sizing of components.

UNIT III: Illumination Systems (6 Hours) Understanding various terms regarding light, lumen, intensity, candle power, lamp efficiency, specific consumption, glare, space to height ratio, waste light factor, depreciation factor, various illumination schemes, Incandescent lamps and modern luminaries like CFL, LED and their operation, energy saving in illumination systems, design of a lighting scheme for a residential and commercial premises, flood lighting.

UNIT IV: Industrial Electrical Systems I (8 Hours) HT connection, industrial substation, Transformer selection, Industrial loads, motors, starting of motors, SLD, Cable and Switchgear selection, Lightning Protection, Earthing design, Power factor correction – kVAR calculations, type of compensation, Introduction to PCC, MCC panels. Specifications of LT Breakers, MCB and other LT panel components.

UNIT V: Industrial Electrical Systems II (6 Hours) DG Systems, UPS System, Electrical Systems for the elevators, Battery banks, Sizing the DG, UPS and Battery Banks, Selection of UPS and Battery Banks.

Industrial Electrical System Automation (6 Hours) Study of basic PLC, Role of in automation, advantages of process automation, PLC based control system design, Panel Metering and Introduction to SCADA system for distribution automation.

Text/Reference Books

2. S.L. Uppal and G.C. Garg, “Electrical Wiring, Estimating & Costing”, Khanna publishers, 2008.

3. K. B. Raina, “Electrical Design, Estimating & Costing”, New age International, 2007.

4. S. Singh and R. D. Singh, “Electrical estimating and costing”, Dhanpat Rai and Co., 1997.

5. Web site for IS Standards.

6. H. Joshi, “Residential Commercial and Industrial Systems”, McGraw Hill Education, 2008.

BHSM-804	Principles of Management	L-T-P-C: 3-0-0-3
CO1	Remembering the concept of Management, human relation and skills of management	
CO2	Understand the meaning of planning , strategic management	
CO3	Understand the steps of Decision Making and Technique	
CO4	Remembering of the nature of organisation, motivational technique, leaderships etc.	
C05	Performs and evaluate of budgetary and no budgetary control technique	

UNIT I

Definition of management, science or art, manager vs entrepreneur; Types of managers-managerial roles and skills; Evolution of management- scientific, human relations, system and contingency approaches; Types of Business Organizations, sole proprietorship, partnership, company, public and private enterprises; Organization culture and environment; Current trends and issues in management.

UNIT II

Nature and purpose of Planning, types of Planning, objectives, setting objectives, policies, Strategic Management, Planning Tools and Techniques, Decision making steps & processes.

UNIT III

Nature and purpose of Organizing, formal and informal organization, organization structure, types, line and staff authority, departmentalization, delegation of authority, centralization and decentralization, job design, human resource management, HR planning, Recruitment selection

UNIT IV

Training & Development, Performance Management, Career planning and Management. Directing, individual and group behavior, motivation, motivation theories, motivational techniques, job satisfaction, job enrichment, leadership, types & theories of leadership, effective communication.

UNIT V

Controlling, system and process of controlling, budgetary and non-budgetary control techniques, use of computers and IT in management control, productivity problems and management, control and performance, direct and preventive control, reporting.

Text Books:

1. Robins S.P. and Couiter M., Management, Prentice Hall India, 10th ed., 2009.

2. Stoner JAF, Freeman RE and Gilbert DR, Management, 6th ed., Pearson Education, 2004.

3. Tripathy PC & Reddy PN, Principles of Management, Tata McGraw Hill, 1999.

BEE-851 Electrical CAD and Fabrication Lab 0-0-2-1

Conduct at least any 10 experiments

1. Simulation of Transient response of RLC Circuit To an input (i) step (ii) pulse and(iii) Sinusoidal signals

2. Transformer design & Fabrication.

3. Small Power Supply design & Fabrication.

4. Filter design & Fabrication.

5. Controller design & Fabrication.

6. Inductor design and Fabrication.

7. Measurement of electrical parameters of AC & DC machine.

8. Design & Fabrication of High Power factor controlled rectifier.

9. Design & Fabrication of Microcontroller based digital energy meters / sensors.

10. Design & Fabrication of Power amplifier.

11. Design Fabrication of AC phase converter and its firing circuit.

12. IGBT based single phase inverter design and Fabrication.

13. Design & Fabrication of chopper.

14. Simulation of single Phase Inverter with PWM control

DEPARTMET ELECTIVES

DEEE-501	Micro Electro Mechanical Systems	L-T-P-C: 3-0-0-3
Course Outcomes: At the end of this course students will demonstrate the ability to		
CO1	Understand different materials used and the rudiments of Micro fabrication techniques.	
CO2	Understand and analyse the operation of various sensors and actuators	
CO3	Choose application of MEMS to real life problems	

UNIT I : INTRODUCTION [10 hours]

Intrinsic Characteristics of MEMS – Energy Domains and Transducers- Sensors and Actuators – Introduction to Micro fabrication – Silicon based MEMS processes – New Materials – Review of Electrical and Mechanical concepts in MEMS – Semiconductor devices – Stress and strain analysis – Flexural beam bending- Torsional deflection.

UNIT II : SENSORS AND ACTUATORS-I [9 hours]

Electrostatic sensors – Parallel plate capacitors – Applications – Inter-digitated Finger capacitor – Comb drive devices – Micro Grippers – Micro Motors – Thermal Sensing and Actuation – Thermal expansion – Thermal couples – Thermal resistors – Thermal Bimorph – Applications – Magnetic Actuators – Micromagnetic components – Case studies of MEMS in magnetic actuators- Actuation using Shape Memory Alloys

UNIT III : SENSORS AND ACTUATORS-II [9 hours]

Piezoresistive sensors – Piezoresistive sensor materials – Stress analysis of mechanical elements – Applications to Inertia, Pressure, Tactile and Flow sensors – Piezoelectric sensors and actuators – piezoelectric effects – piezoelectric materials – Applications to Inertia , Acoustic, Tactile and Flow sensors.

TEXT BOOKS:

1. Chang Liu, “Foundations of MEMS”, Pearson Education Inc., 2006.
2. Stephen D Senturia, “Microsystem Design”, Springer Publication, 2000.
3. Tai Ran Hsu, “MEMS & Micro systems Design and Manufacture” Tata McGraw Hill, New Delhi, 2002.

REFERENCES:

1. Nadim Maluf,“ An Introduction to Micro Electro Mechanical System Design”, Artech House, 2000.
2. Mohamed Gad-el-Hak, editor, “ The MEMS Handbook”, CRC press Baco Raton, 2000

DEEE-502	Introduction to Power Plant Engineering	L-T-P-C: 3-0-0-3
Course Outcomes: At the end of this course students will demonstrate the ability to		
CO1	Describe the layout and the operation of all parts of a Hydro-electric power plant	
CO2	Explain the layout and the operation of all parts of a Thermal power plant	
CO3	Comprehend the layout and the operation of all parts of a Nuclear power plant	
CO4	Understand Wind power generation and Solar Power generation and all the equipment involved in it	
C05	Understand plant selection, choice of size and number of Generators in combined operation of power plants	

UNIT I Hydro-electric power plants – selection of site, elements of power plant, classification, water turbines, governor action, hydro-electric generator, plant layout, pumped storage plants.

UNIT II Thermal Steam power plants – selection of site, elements and operational circuits of the power plant, turbo-alternators, plant layout, steam turbines, controls and auxiliaries.

UNIT III Nuclear power plants – selection of site, nuclear reaction – fission process and chain reaction, constituents of power plant and layout, nuclear reactor – working, classification, control, shielding and waste disposal.

UNIT IV Renewable power plants – Solar power generation – Photo-voltaic and solar thermal generation – solar concentrators, Wind power generation – types of wind mills, wind generators, tidal, biomass, geothermal and magneto-hydro dynamic power generation, micro-hydel power plants, fuel cells and diesel and gas power plants.

UNIT V Combined operation of power plants – plant selection, choice of size and number of generator units, interconnected systems, real and reactive power exchange among interconnected systems. Power plant economics: load curve, different terms and definitions, cost of electrical energy, tariffs methods of electrical energy, performance & operating characteristics of power plants, Economic Load Sharing.

Text Books:

1. Chakrabarti A., Soni M.L., Gupta P.V., and Bhatnagar U.S., 'A text book on Power Systems Engg.', DhanpatRai and Sons, New Delhi, 2nd revised edition, 2010.

2. JB Gupta, ‘A course in Power Systems’, S.K. Kataria and sons, reprint 2010-2011.

Reference Books:

1. Wadhwa, C.L., ‘Generation Distribution and Utilization of Electrical Energy', New Age International publishers, 3rd edition, 2010.

2. Deshpande M.V, `Elements of Electrical Power systems Design’, Pitman, New Delhi, PHI Learning Private Limited, 1st edition, 2009.

DEEE-503	Electrical & Electronics Engineering Materials	L-T-P-C: 3-0-0-3
Course Outcomes: At the end of this course students will demonstrate the ability to		
CO1	Understand bonds, energy bands and classification of materials	
CO2	Comprehend conductivity in Metals	
CO3	Explain the mechanism of conduction in semiconductor materials	
CO4	Recount magnetic properties of materials	

UNIT – I Crystal Structure of Materials:

A. Bonds in solids, crystal structure, co-ordination number, atomic packing factor, Miller Indices, Bragg's law and x-ray diffraction, structural Imperfections, crystal growth

B. Energy bands in solids, classification of materials using energy band.

UNIT – II Conductivity of Metals:

Electron theory of metals, factors affecting electrical resistance of materials, thermal conductivity of metals, heat developed in current carrying conductors, thermoelectric effect, superconductivity and super conducting materials, Properties and applications of electrical conducting and insulating materials, mechanical properties of metals

UNIT – III Mechanism of Conduction in semiconductor materials:

Types of semiconductors, current carriers in semiconductors, Half effect, Drift and Diffusion currents, continuity equation, P-N junction diode, junction transistor, FET & IGFET, properties of semiconducting materials.

UNIT – IV Magnetic Properties of Material:

Origin of permanent magnetic dipoles in matters, Classification Diamagnetism, Paramagnetism, Ferromagnetism, Antiferromagnetism and Ferrimagnetism, magnetostriction, properties of magnetic materials, soft and hard magnetic materials, permanent magnetic materials.

Text Books :

1 A.J. Dekker, "Electrical Engineering Materials" Prentice Hall of India

2 R.K. Rajput," Electrical Engg. Materials," Laxmi Publications.

3 C.S. Indulkar & S.Triruvagdan "An Introduction to Electrical Engg. Materials, S. Chand & Co.

References:

1 Solymar, "Electrical Properties of Materials" Oxford University Press.

2 Ian P. Hones," Material Science for Electrical and Electronic Engineering," Oxford University Press

3 G.P. Chhalotra & B.K. Bhat, "Electrical Engineering Materials" Khanna Publishers.

4 T. K. Basak, "Electrical Engineering Materials" New age International.

DEEE-504	Artificial Intelligence	L-T-P-C: 3-0-0-3
Course Outcomes: At the end of this course students will demonstrate the ability to		
CO1	Explain basic AI algorithms	
CO2	Represent Knowledge using rules and rule based deduction	
CO3	Understand the concept of approximate reasoning and be able to apply it through statistical, fuzzy reasoning etc	
CO4	Comprehend machine learning by ANN, Genetic algorithm	
C05	Exhibit knowledge of AI applications to Robotics and other intelligent systems	

UNIT-I FOUNDATIONAL ISSUES IN ARTIFICIAL INTELLIGENCE:

Foundation and history of AI, AI problems and techniques, AI programming languages, Introduction to LISP and PROLOG, problem spaces and searches, blind search strategies, Breadth first- Depth first - heuristic search techniques, Hill climbing, best first - A* algorithm, AO* algorithm- game tree, Min max algorithms, game playing- alpha beta pruning.

UNIT-II KNOWLEDGE REPRESENTATION:

Issues, predicate logic, logic programming, semantic nets, frames and inheritance, constraint propagation, representing knowledge using rules, rules based deduction systems.

UNIT III APPROXIMATE REASONING:

Reasoning under uncertainty, review of probability, Baye's probabilistic inferences and Dempster Shafer theory, Heuristic methods, symbolic reasoning under uncertainty, Statistical reasoning, Fuzzy reasoning, Temporal reasoning, Non-monotonic reasoning.

UNIT-IV PLANNING & LEARNING:

Planning in situational calculus, Representation for planning, Partial order planning algorithm, Learning from examples, Discovery as learning, Learning by analogy, Explanation based learning, Introductory remarks on learning by Neural Networks and Genetic Algorithms.

UNIT-V APPLICATIONS:

Rule based systems architecture, Expert systems, Knowledge acquisition concepts, AI application to robotics, and current trends in intelligent systems.

TEXT BOOK:

1. Artificial Intelligence: A Modern Approach,. Russell & Norvig. Prentice Hall, 1995.

REFERENCE BOOKS:

1. Elain Rich and Kevin Knight, "Artificial Intelligence", TMH, 1991.

2. Staurt Russel and Peter Norvig, "Artificial Intelligence - A modern approach", PHI, 1998.

3. Patrick Henry Winston, "Artificial intelligence", 3rd Ed., Addition Wesley, 1992. 4. Dan W. Patterson, "Artificial Intelligence", PHI, 1990

DEEE-601	Soft Computing	L-T-P-C: 3-1-0-4
Course Outcomes: At the end of this course students will demonstrate the ability to		
CO1	Artificial Intelligence, Various types of production systems, characteristics of production systems	
CO2	Neural Networks, architecture, functions and various algorithms involved	
CO3	Fuzzy Logic, Various fuzzy systems and their functions	
CO4	Genetic algorithms, its applications and advances	
C05	The unified and exact mathematical basis as well as the general principles of various soft -computing techniques.	

UNIT I

Introduction To Soft Computing And Neural Networks : Evolution of Computing - Soft Computing Constituents – From Conventional AI to Computational Intelligence - Adaptive Networks – Feed forward Networks – Supervised Learning

UNIT II

Neural Networks – Radia Basis Function Networks - Reinforcement Learning – Unsupervised Learning Neural Networks – Adaptive Resonance architecture

Fuzzy Sets and Fuzzy Logic: Fuzzy Sets – Operations on Fuzzy Sets – Fuzzy Relations - Fuzzy Rules and Fuzzy Reasoning

UNIT III

Fuzzy Inference Systems – Fuzzy Expert Systems – Fuzzy Decision Making Neuro-Fuzzy Modeling : Adaptive Neuro-Fuzzy Inference Systems – Coactive Neuro-Fuzzy Modeling – Classification and Regression Trees

UNIT IV

Data Clustering Algorithms – Rule based Structure Identification, Neuro-Fuzzy Control

Machine Learning: Machine Learning Techniques – Machine Learning Using Neural Nets – Genetic Algorithms (GA)

UNIT V

Applications of GA in Machine Learning - Machine Learning Approach to Knowledge Acquisition. Support Vector Machines for Learning – Linear Learning Machines – Support Vector Classification – Support Vector Regression - Applications

Text Book:

1. Digital Neural Network -S.Y Kung , Prentice-Hall of India

2. James A. Freeman and David M. Skapura, “Neural Networks Algorithms, Applications, and Programming Techniques”, Pearson Edn.,

3. Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani, “Neuro-Fuzzy and Soft Computing”, Prentice-Hall of India,

References:

1. Amit Konar, “Artificial Intelligence and Soft Computing”, First Edition,CRC Press, 2000.

2. David E. Goldberg, Genetic Algorithms in Search, Optimization and Machine Learning”, Addison Wesley

3. George J. Klir and Bo Yuan, “Fuzzy Sets and Fuzzy Logic-Theory and Applications”, Prentice Hall

4. Mitchell Melanie, “An Introduction to Genetic Algorithm”, Prentice Hall, 1998. 5. Simon Haykin, “Neural Networks: A Comprehensive Foundation”, Prentice Hall,

DEEE-602	EHV AC & DC Transmission	L-T-P-C: 3-1-0-4
Course Outcomes: At the end of this course students will demonstrate the ability to		
CO1	Understand the need of EHV transmission and their applications	
CO2	Explain losses and switching surges in EHV AC transmission and methods to reduce them	
CO3	Comprehend methods of Extra High Voltage Testing	
CO4	Describe types EHV DC transmission links	
C05	Comprehend faults that can occur in EHV DC transmission and the protection	

UNIT I: Introduction

Need of EHV transmission, standard transmission voltage, comparison of EHV AC & DC transmission systems and their applications & limitations, surface voltage gradients in conductor, distribution of voltage gradients on sub-conductors, mechanical considerations of transmission lines, modern trends in EHV AC and DC transmission

UNIT-II: EHV AC Transmission:

Corona loss formulas, corona current, audible noise – generation and characteristics corona pulses their generation and properties, radio interference (RI) effects, over voltage due to switching, ferro-resonance, reduction of switching surges on EHV system, principle of half wave transmission.

UNIT-III: Extra High Voltage Testing:

Characteristics and generation of impulse voltage, generation of high AC and DC voltages, measurement of high voltage by sphere gaps and potential dividers. Consideration for Design of EHV Lines: Design factors under steady state limits, EHV line insulation design based upon transient over voltages. Effects of pollution on performance of EHV lines.

UNIT-IV: EHV DC Transmission – I:

Types of dc links, converter station, choice of converter configuration and pulse number, effect of source inductance on operation of converters. Principle of DC link control, converter controls characteristics, firing angle control, current and excitation angle control, power control, starting and stopping of DC link.

UNIT-V:EHV DC Transmission – II:

Converter faults, protection against over currents and over voltages, smoothing reactors, generation of harmonics, AC and DC filters, Multi Terminal DC systems (MTDC): Types, control, protection and applications.

Text Books:

1.R. D. Begamudre, “Extra High Voltage AC Transmission Engineering” Wiley Eastern.

2.K. R. Padiyar, “HVDC Power Transmission Systems: Technology and System Reactions” New Age International.

3.J. Arrillaga,“ High Voltage Direct current Transmission” IFFE Power Engineering Series 6, Peter Peregrinus Ltd, London.

4.M. S. Naidu & V. Kamaraju, “High Voltage Engineering” Tata Mc Graw Hill. Reference Books:

5.M. H. Rashid , “ Power Electronics : Circuits, Devices and Applications” Prentice Hall of India. 6.S. Rao, “EHV AC and HVDC Transmission Engineering and Practice” Khanna Publisher.

7.“EPRI, Transmission Line Reference Book, 345 KV and above” Electric Power Research Institute. Palo Alto, California, 1982.

DEEE-603	Analog and Digital Communication	L-T-P-C: 3-1-0-4
Course Outcomes: At the end of this course students will demonstrate the ability to		
CO1	Exhibit knowledge of Elements of communication system	
CO2	Understand Phase modulation Techniques	
CO3	Understand Pulse modulation systems	
CO4	Analyse digital modulation Techniques	
C05	Analyse information coding techniques	

UNIT I:

Elements of communication system and its limitations - Amplitude Modulation: Amplitude modulation and detection, Generation and detection of DSB-SC, SSB and vestigial side band modulation, carrier acquisition AM transmitters and receivers, super hetrodyne receiver, IF amplifiers, AGC circuits Frequency Division multiplexing

UNIT II:

Angle Modulation: Basic definitions Narrow band and wideband frequency modulation, transmission bandwidth of FM signals Generation and detection of frequency modulation Noise: External noise, internal noise Noise calculations, signal to noise ratio Noise in AM and FM systems

UNIT III:

Pulse Modulation: Introduction, sampling process Analog Pulse Modulation Systems-Pulse Amplitude Modulation, Pulse width modulation and Pulse Position Modulation. Waveform coding Techniques: Discretization in time and amplitude, Quantization process, quantization noise, Pulse code Modulation, Differential Pulse code Modulation, Delta Modulation and Adaptive Delta Modulation.

UNIT IV:

Digital Modulation Techniques: Types of digital modulation, waveforms for amplitude, frequency and phase shift keying, methods of generation of coherent and non-coherent, ASK,FSK and PSK, comparison of above digital techniques.

UNIT V:

Time Division Multiplexing: Fundamentals, Electronic Commutator, Bit/byte interleaving, TI carrier system, synchronization and signaling of TI, TDM and PCM hierarchy, synchronization techniques Introduction to Information Theory: Measure of information, Entropy & Information rate, channel capacity, Hartley Shannan law, Huffman coding, Shannan Fano coding.

Text Books:

1. Simon Haykin,“ Communication Systems” John Wiley & Sons 4th Edition

2. G.Kennedy and B. Davis,” Electronic Communication Systems” 4th Edition, Tata McGraw Hill

3. Simon Haykin, “Digital Communications” John Wiley & Sons

4. T.L. Singal, “Analog & Digital Communication”, Tata Mc Graw Hill

Reference Books:

1. B.P. Lathi, “Modern Analog & Digital Communication Systems” Oxford University Press.

2. Taub & Schilling, “Communication System: Analog and Digital” Tata Mc Graw Hill

3. R.P. Singh & S.D. Sapre, “Communication Systems Analog and Digital” Tata McGraw Hill.

DEEE-604	Electrical Machine Design	L-T-P-C: 3-1-0-4
Course Outcomes: At the end of this course students will demonstrate the ability to		
CO1	Understand the construction and performance characteristics of electrical machines	
CO2	Grasp the various factors which influence the design of Transformers: electrical, magnetic and thermal loading of electrical machines	
CO3	Comprehend the principles of electrical machine design and carry out a basic design of an Induction Motor	
CO4	Carry out a basic design of an Synchronous Machine	
C05	Use software tools to do design calculations	

UNIT I: Introduction Major considerations in electrical machine design, electrical engineering materials, space factor, choice of specific - electrical and magnetic loadings, thermal considerations, heat flow, temperature rise, rating of machines.

UNIT II: Transformers Sizing of a transformer, main dimensions, kVA output for single- and three-phase transformers, window space factor, overall dimensions, operating characteristics, regulation, no load current, temperature rise in transformers, design of cooling tank, methods for cooling of transformers.

UNIT III: Induction Motors Sizing of an induction motor, main dimensions, length of air gap, rules for selecting rotor slots of squirrel cage machines, design of rotor bars & slots, design of end rings, design of wound rotor, magnetic leakage calculations, leakage reactance of poly-phase machines, magnetizing current, short circuit current, circle diagram, operating characteristics.

UNIT IV: Synchronous Machines Sizing of a synchronous machine, main dimensions, design of salient pole machines, short circuit ratio, shape of pole face, armature design, armature parameters, estimation of air gap length, design of rotor, design of damper winding, determination of full load field mmf, design of field winding, design of turbo alternators, rotor design.

UNIT V: Computer aided Design (CAD): Limitations (assumptions) of traditional designs, need for CAD analysis, synthesis and hybrid methods, design optimization methods, variables, constraints and objective function, problem formulation. Introduction to FEM based machine design. Introduction to complex structures of modern machines-PMSMs, BLDCs, SRM and claw-pole machines.

Text / References:

1. A. K. Sawhney, "A Course in Electrical Machine Design", Dhanpat Rai and Sons, 1970.
2. M.G. Say, "Theory & Performance & Design of A.C. Machines", ELBS London.
3. S. K. Sen, "Principles of Electrical Machine Design with computer programmes", Oxford and IBH Publishing, 2006.
4. K. L. Narang, "A Text Book of Electrical Engineering Drawings", SatyaPrakashan, 1969.
5. A. Shanmugasundaram, G. Gangadharan and R. Palani, "Electrical Machine Design Data Book", New Age International, 1979.

6. K. M. V. Murthy, “Computer Aided Design of Electrical Machines”, B.S. Publications, 2008.
7. Electrical machines and equipment design exercise examples using Ansoft’s Maxwell 2D machine design package.

DEEE-701	Wind and Solar Energy Systems	L-T-P-C: 3-1-0-4
Course Outcomes: At the end of this course students will demonstrate the ability to		
CO1	Understand the energy scenario and the consequent growth of the power generation from renewable energy sources	
CO2	Explain the basic physics of wind and solar power generation	
CO3	Comprehend the power electronic interfaces for wind and solar generation	
CO4	Analyse the issues related to the grid-integration of solar and wind energy systems	

Unit I: Physics of Wind Power: (5 Hours)

History of wind power, Indian and Global statistics, Wind physics, Betz limit, Tip speed ratio, stall and pitch control, Wind speed statistics-probability distributions, Wind speed and power-cumulative distribution functions.

Unit II: Wind generator topologies: (12 Hours)

Review of modern wind turbine technologies, Fixed and Variable speed wind turbines, Induction Generators, Doubly-Fed Induction Generators and their characteristics, Permanent-Magnet Synchronous Generators, Power electronics converters. Generator-Converter configurations, Converter Control.

Unit III: The Solar Resource: (3+8 Hours)

Introduction, solar radiation spectra, solar geometry, Earth Sun angles, observer Sun angles, solar day length, Estimation of solar energy availability.

Solar photovoltaic: Technologies-Amorphous, mono-crystalline, polycrystalline; V-I characteristics of a PV cell, PV module, array, Power Electronic Converters for Solar Systems, Maximum Power Point Tracking (MPPT) algorithms. Converter Control.

Unit IV: Network Integration Issues: (8 Hours)

Overview of grid code technical requirements. Fault ride-through for wind farms - real and reactive power regulation, voltage and frequency operating limits, solar PV and wind farm behavior during grid disturbances. Power quality issues. Power system interconnection experiences in the world. Hybrid and isolated operations of solar PV and wind systems.

Unit V: Solar thermal power generation: (3 Hours)

Technologies, Parabolic trough, central receivers, parabolic dish, Fresnel, solar pond, elementary analysis.

Text / References:

1. T. Ackermann, “Wind Power in Power Systems”, John Wiley and Sons Ltd., 2005.

2. G. M. Masters, “Renewable and Efficient Electric Power Systems”, John Wiley and Sons, 2004.

3. S. P. Sukhatme, “Solar Energy: Principles of Thermal Collection and Storage”, McGraw Hill, 1984.

4. H. Siegfried and R. Waddington, “Grid integration of wind energy conversion systems” John Wiley and Sons Ltd., 2006.

5. G. N. Tiwari and M. K. Ghosal, “Renewable Energy Applications”, Narosa Publications, 2004.

6. J. A. Duffie and W. A. Beckman, “Solar Engineering of Thermal Processes”, John Wiley & Sons, 1991.

DEEE-702	Microcontrollers and Embedded Systems	L-T-P-C: 3-1-0-4
Course Outcomes: At the end of this course students will demonstrate the ability to		
CO1	Describe the architectural features and instructions of ARM microcontroller	
CO2	Apply the knowledge gained for Programming ARM for different applications	
CO3	Interface external devices and I/O with ARM microcontroller.	
CO4	Interpret the basic hardware components and their selection method based on the characteristics and attributes of an embedded system	
CO5	Demonstrate the need of real time operating system for embedded system applications	

UNIT I

Microprocessors versus Microcontrollers, ARM Embedded Systems: The RISC design philosophy, The ARM Design Philosophy, Embedded System Hardware, Embedded System Software.

ARM Processor Fundamentals: Registers, Current Program Status Register, Pipeline,

Exceptions, Interrupts, and the Vector Table , Core Extensions

UNIT II

Introduction to the ARM Instruction Set: Data Processing Instructions, Programme

Instructions, Software Interrupt Instructions, Program Status Register Instructions, Coprocessor Instructions, Loading Constants

ARM programming using Assembly language: Writing Assembly code, Profiling and cycle counting, instruction scheduling, Register Allocation, Conditional Execution, Looping Constructs

UNIT III

Embedded System Components: Embedded Vs General computing system, History of embedded systems, Classification of Embedded systems, Major applications areas of embedded systems, purpose of embedded systems

Core of an Embedded System including all types of processor/controller, Memory, Sensors,

Actuators, LED, 7 segment LED display, stepper motor, Keyboard, Push button switch, Communication Interface (onboard and external types), Embedded firmware, Other system components.

UNIT IV

Embedded System Design Concepts: Characteristics and Quality Attributes of Embedded Systems, Operational quality attributes, non-operational quality attributes, Embedded

Systems-Application and Domain specific, Hardware Software Co-Design and Program Modelling, embedded firmware design and development

UNIT V

RTOS and IDE for Embedded System Design: Operating System basics, Types of operating systems, Task, process and threads (Only POSIX Threads with an example program), Thread preemption, Multiprocessing and Multitasking, Task Communication (without any program), Task synchronization issues – Racing and Deadlock

Binary and counting semaphores (Mutex example without any program), How to choose an RTOS, Integration and testing of Embedded hardware and firmware, Embedded system Development Environment – Block diagram (excluding Keil), Disassembler/decompiler, simulator, emulator and debugging techniques, target hardware debugging, boundary scan.

Textbooks:

1. Andrew N Sloss, Dominic Symes and Chris Wright, ARM system developers guide, Elsevier, Morgan Kaufman publishers, 2008.

2. Shibu K V, "Introduction to Embedded Systems", Tata McGraw Hill Education, Private Limited, 2nd Edition.

Reference Books:

1. Raghunandan..G.H, Microcontroller (ARM) and Embedded System, Cengage learning Publication,2019

2. The Insider's Guide to the ARM7 Based Microcontrollers, Hitex Ltd.,1st edition, 2005.

3. Steve Furber, ARM System-on-Chip Architecture, Second Edition, Pearson, 2015.

4. Raj Kamal, Embedded System, Tata McGraw-Hill Publishers, 2nd Edition, 2008.

DEEE-703	Digital Control Systems	L-T-P-C: 3-1-0-4
Course Outcomes: At the end of this course students will demonstrate the ability to		
CO1	Obtain discrete representation of LTI systems.	
CO2	Analyse discrete LTI systems by Z transforms	
CO3	Analyse stability of open loop and closed loop discrete-time systems	
CO4	Design and analyse digital controllers	
C05	Design state feedback and output feedback controllers	

UNIT I: Discrete Representation of Continuous Systems (6 hours)

Basics of Digital Control Systems. Discrete representation of continuous systems. Sample and hold circuit. Mathematical Modelling of sample and hold circuit. Effects of Sampling and Quantization. Choice of sampling frequency. ZOH equivalent.

UNIT II:

Discrete System Analysis (6 hours)

Z-Transform and Inverse Z Transform for analyzing discrete time systems. Pulse Transfer function. Pulse transfer function of closed loop systems. Mapping from s-plane to z plane. Solution of Discrete time systems. Time response of discrete time system.

Stability of Discrete Time System (4 hours)

Stability analysis by Jury test. Stability analysis using bilinear transformation. Design of digital control system with dead beat response. Practical issues with dead beat response design.

UNIT III: State Space Approach for discrete time systems (10 hours)

State space models of discrete systems, State space analysis. Lyapunov Stability. Controllability, reach-ability, Reconstructibility and observability analysis. Effect of pole zero cancellation on the controllability & observability.

UNIT IV: Design of Digital Control System (8 hours)

Design of Discrete PID Controller, Design of discrete state feedback controller. Design of set point tracker. Design of Discrete Observer for LTI System. Design of Discrete compensator.

UNIT V: Discrete output feedback control (8 hours)

Design of discrete output feedback control. Fast output sampling (FOS) and periodic output feedback controller design for discrete time systems.

Text Books:

1. K. Ogata, “Digital Control Engineering”, Prentice Hall, Englewood Cliffs, 1995.

2. M. Gopal, “Digital Control Engineering”, Wiley Eastern, 1988.

3. G. F. Franklin, J. D. Powell and M. L. Workman, “Digital Control of Dynamic Systems”, Addison-Wesley, 1998.

4. B.C. Kuo, “Digital Control System”, Holt, Rinehart and Winston, 1980.

DEEE-704	Energy Audit	L-T-P-C: 3-1-0-4
Course Outcomes: At the end of this course students will demonstrate the ability to		
CO1	Understand the Power distribution system planning, operation and maintenance	
CO2	Describe the types of Energy auditing and energy audit instruments.	
CO3	Explain the short and long term measures to reduce loss and improve energy efficiency	
CO4	Understand Demand Side Management	

UNIT I: INTRODUCTION TO THE POWER DISTRIBUTION SYSTEM:

Description of the power distribution system- voltage levels, Components of the distribution system- Substation, Transformer, feeders, distribution system planning, operation & maintenance objectives, activities involved in O&M, grid management, load scheduling & dispatch, load balancing, 6633/ 11 KV substation equipment, 11/ 0.4 KV substation equipment, Distribution transformers- reasons for DT failures.

UNIT II: ENERGY ACCOUNTING & ENERGY AUDIT:

Need for energy accounting, objectives & functions of energy accounting, Energy flow diagram in power distribution system, energy accounting procedure- Energy measurement, and problems in energy accounting & overcoming these problems in energy accounting, Definition, need and types of energy audit, energy audit instruments, procedure for conducting an energy audit.

UNIT III: AT&C LOSS REDUCTION & EFFICIENCY IMPROVEMENT:

Concepts and principles of distribution losses- transmission & distribution losses, AT&C losses in power distribution network, factors contributing to high technical & commercial losses. Technical loss reduction- Short term measures for technical loss reduction, long term plans for technical loss reduction, Commercial loss reduction- reasons for commercial losses, measures for commercial loss reduction.

UNIT IV: DEMAND SIDE MANAGEMENT:

An introduction, Why DSM?, Benefits of DSM, DSM in power systems: load management, DSM techniques and emerging trends, EC Act 2001, DSM on consumer side – the industrial sector, the agricultural sector, the domestic & commercial sectors, ESCO-a route for DSM.

TEXT BOOKS:

1. Handbook of Energy Engineering, The Fairmont Press, INC.-Albert Thumann & Paul Mehta.

2. Energy Management Supply & Conservation, Butterworth Heinemann, 2002-dr. Clive Beggs.

REFERENCE BOOKS:

1. Hand book on energy audit & environment management by ISBN 81-1993.0920 TERI

DEEE-801	Power Quality and FACTS	L-T-P-C: 3-1-0-4
Course Outcomes: At the end of this course students will demonstrate the ability to		
CO1	Explain the characteristics of ac transmission and the effect of shunt and series reactive compensation	
CO2	Comprehend the basic concepts of power quality and the controllers	
CO3	Understand the working principles of FACTS devices and their operating characteristics	
CO4	Application of FACTS to Power Flow Control and to distribution systems	
C05	Describe the working principles of devices used to improve power quality and be familiar with UPQC	

UNIT I:

Transmission Lines and Series/Shunt Reactive Power Compensation (4 hours)

Basics of AC Transmission. Analysis of uncompensated AC transmission lines. Passive Reactive Power Compensation. Shunt and series compensation at the mid-point of an AC line. Comparison of Series and Shunt Compensation.

Thyristor-based Flexible AC Transmission Controllers (FACTS) (6 hours)

Description and Characteristics of Thyristor-based FACTS devices: Static VAR Compensator (SVC), Thyristor Controlled Series Capacitor (TCSC), Thyristor Controlled Braking Resistor and Single Pole Single Throw (SPST) Switch. Configurations/Modes of Operation, Harmonics and control of SVC and TCSC. Fault Current Limiter.

UNIT II:

Voltage Source Converter based (FACTS) controllers (8 hours)

Voltage Source Converters (VSC): Six Pulse VSC, Multi-pulse and Multi-level Converters, Pulse-Width Modulation for VSCs. Selective Harmonic Elimination, Sinusoidal PWM and Space Vector Modulation. STATCOM: Principle of Operation, Reactive Power Control: Type I and Type II controllers, Static Synchronous Series Compensator (SSSC) and Unified Power Flow Controller (UPFC): Principle of Operation and Control. Working principle of Interphase Power Flow Controller. Other Devices: GTO Controlled Series Compensator. Fault Current Limiter.

UNIT III:

Application of FACTS (4 hours)

Application of FACTS devices for power-flow control and stability improvement. Simulation example of power swing damping in a single-machine infinite bus system using a TCSC. Simulation example of voltage regulation of transmission mid-point voltage using a STATCOM.

Power Quality Problems in Distribution Systems (4 hours)

Power Quality problems in distribution systems: Transient and Steady state variations in voltage and frequency. Unbalance, Sags, Swells, Interruptions, Wave-form Distortions: harmonics,

noise, notching, dc-offsets, fluctuations. Flicker and its measurement. Tolerance of Equipment: CBEMA curve.

UNIT IV:

DSTATCOM (8 hours)

Reactive Power Compensation, Harmonics and Unbalance mitigation in Distribution Systems using DSTATCOM and Shunt Active Filters. Synchronous Reference Frame Extraction of Reference Currents. Current Control Techniques in for DSTATCOM.

UNIT V:

Dynamic Voltage Restorer and Unified Power Quality Conditioner (6 hours)

Voltage Sag/Swell mitigation: Dynamic Voltage Restorer – Working Principle and Control Strategies. Series Active Filtering. Unified Power Quality Conditioner (UPQC): Working Principle. Capabilities and Control Strategies.

Text/References

1. N. G. Hingorani and L. Gyugyi, “Understanding FACTS: Concepts and Technology of FACTS Systems”, Wiley-IEEE Press, 1999.

2. K. R. Padiyar, “FACTS Controllers in Power Transmission and Distribution”, New Age International (P) Ltd. 2007.

3. T. J. E. Miller, “Reactive Power Control in Electric Systems”, John Wiley and Sons, New York, 1983.

4. R. C. Dugan, “Electrical Power Systems Quality”, McGraw Hill Education, 2012.

5. G. T. Heydt, “Electric Power Quality”, Stars in a Circle Publications, 1991

DEEE-802	Digital Image & Video Processing	L-T-P-C: 3-1-0-4
Course Outcomes: At the end of this course students will demonstrate the ability to		
CO1	Mathematically represent the various types of images and analyse them	
CO2	Process these images for the enhancement of certain properties or for optimized use of the resources	
CO3	Appreciate the use of wavelet transformation in Image processing	
CO4	Develop algorithms for image compression and coding	
C05	Understand video coding and video segmenting	

UNIT I

Digital Image Fundamentals-Elements of visual perception, image sensing and acquisition, image sampling and quantization, basic relationships between pixels – neighborhood, adjacency, connectivity, distance measures.

Image Enhancements and Filtering - Gray level transformations, histogram equalization and specifications, pixel-domain smoothing filters – linear and order-statistics, pixel-domain sharpening filters – first and second derivative, two-dimensional DFT and its inverse, frequency domain filters – low-pass and high-pass.

UNIT II

Color Image Processing - Color models–RGB, YUV, HSI; Color transformations– formulation, color complements, color slicing, tone and color corrections; Color image smoothing and sharpening; Color Segmentation.

Image Segmentation- Detection of discontinuities, edge linking and boundary detection, thresholding – global and adaptive, region-based segmentation.

UNIT III

Wavelets and Multi-resolution image processing- Uncertainty principles of Fourier Transform, Time frequency localization, continuous wavelet transforms, wavelet bases and multi-resolution analysis, wavelets and Sub-band filter banks, wavelet packets.

UNIT IV

Image Compression-Redundancy–inter-pixel and psycho-visual; Lossless compression – predictive, entropy; Lossy compression-predictive and transform coding; Discrete Cosine Transform; Still image compression standards–JPEG and JPEG-2000

UNIT V

Fundamentals of Video Coding-Inter-frame redundancy, motion estimation techniques – full-search, fast search strategies, forward and backward motion prediction, frame classification – I, P and B; Video sequence hierarchy–Group of pictures, frames, slices, macro-blocks and blocks; Elements of a video encoder and decoder; Video coding standards – MPEG and H.26X.

Video Segmentation-Temporal segmentation–shot boundary detection, hard-cutsand soft-cuts; spatial segmentation–motion-based; Video object detection and tracking.

Text/Reference Books:

1. R.C. Gonzalez and R.E. Woods, Digital Image Processing, Second Edition, Pearson Education 3rd edition 2008

2. Anil Kumar Jain, Fundamentals of Digital Image Processing, Prentice Hall of India.2nd edition 2004 3. Murat Tekalp , Digital Video Processing" Prentice Hall, 2nd edition 2015

DEEE-803	Medical Instrumentation	L-T-P-C: 3-1-0-4
Course Outcomes: At the end of this course students will demonstrate the ability to		
CO1	Define basic medical terms and physical values that can be handled by medical instrumentation	
CO2	Describe methods and implementation of electrical and non- electrical medical parameters diagnostics	
CO3	Analyse the electrical parameters after acquisition	
CO4	Understand medical imaging modalities and analysis	
C05	Comprehend the functioning of **life assisting, therapeutic and robotic devices**	

UNIT I: FUNDAMENTALS OF BIOMEDICAL ENGINEERING

Cell and its structure – Resting and Action Potential – Nervous system and its fundamentals - Basic components of a biomedical system- Cardiovascular systems- Respiratory systems - Kidney and blood flow - Biomechanics of bone - Biomechanics of soft tissues - Basic mechanics of spinal column and limbs -Physiological signals and transducers - Transducers – selection criteria – Piezo electric, ultrasonic transducers - Temperature measurements – Fibre-optic temperature sensors.

UNIT II: NON ELECTRICAL PARAMETERS MEASUREMENT AND DIAGNOSTIC PROCEDURES

Measurement of blood pressure - Cardiac output - Heart rate - Heart sound - Pulmonary function measurements – spirometer – Photo Plethysmography, Body Plethysmography – Blood Gas analysers, pH of blood –measurement of blood pCO2, pO2, finger-tip oxymeter - ESR, GSR measurements.

UNIT III: ELECTRICAL PARAMETERS ACQUISITION AND ANALYSIS

Electrodes – Limb electrodes –floating electrodes – pregelled disposable electrodes - Micro, needle and surface electrodes – Amplifiers, Preamplifiers, differential amplifiers, chopper amplifiers – Isolation amplifier - ECG – EEG – EMG – ERG – Lead systems and recording methods – Typical waveforms - Electrical safety in medical environment, shock hazards – leakage current-Instruments for checking safety parameters of biomedical equipments.

UNIT IV: IMAGING MODALITIES AND ANALYSIS

Radio graphic and fluoroscopic techniques – Computer tomography – MRI – Ultrasonography – Endoscopy – Thermography –Different types of biotelemetry systems - Retinal Imaging - Imaging application in Biometric systems - Analysis of digital images.

UNIT V: LIFE ASSISTING, THERAPEUTIC AND ROBOTIC DEVICES

Pacemakers – Defibrillators – Ventilators – Nerve and muscle stimulators – Diathermy – Heart – Lung machine – Audio meters – Dialysers – Lithotripsy - ICCU patient monitoring system - Nano Robots - Robotic surgery – Advanced 3D surgical techniques- Orthopedic prostheses fixation.

Text Book:

1. J. G. Webster, Medical Instrumentation, Application and Design, John Wiley and Sons

2. L. Cromwell, F. J. Weibell and L. A. Pfeiffer, Biomedical Instrumentation Measurements, Pearson education, Delhi, 1990.

References:

1. R. S. Khandpur, Handbook of Biomedical Instrumentation, Tata Mc Graw Hill

2. J. J. Carr and J. M. Brown, Introduction to Biomedical Equipment Technology, Pearson

DEEE-804	Speech and Audio-processing	L-T-P-C: 3-1-0-4
Course Outcomes: At the end of this course students will demonstrate the ability to		
CO1	Understand Speech production and speech coding	
CO2	Analyse the quality and properties of speech signal	
CO3	Mathematically model the speech signal	
CO4	Modify and enhance the speech and audio signals	

UNIT I

Introduction- Speech production and modeling - Human Auditory System; General structure of speech coders; Classification of speech coding techniques – parametric, waveform and hybrid ; Requirements of speech codecs –quality, coding delays, robustness.

Speech Signal Processing- Pitch-period estimation, all-pole and all-zero filters, convolution; Power spectral density, periodogram, autoregressive model, autocorrelation estimation.

UNIT II

Linear Prediction of Speech- Basic concepts of linear prediction; Linear Prediction Analysis of non-stationary signals –prediction gain, examples; Levinson-Durbin algorithm; Long term and short-term linear prediction models; Moving average prediction.

UNIT III

Speech Quantization- Scalar quantization–uniform quantizer, optimum quantizer, logarithmic quantizer, adaptive quantizer, differential quantizers; Vector quantization – distortion measures, code book design, code book types

Scalar Quantization of LPC- Spectral distortion measures, Quantization based on reflection coefficient and log area ratio, bit allocation; Line spectral frequency – LPC to LSF conversions, quantization based on LSF

UNIT IV

Linear Prediction Coding- LPC model of speech production; Structures of LPC encoders and decoders; Voicing detection; Limitations of the LPC model

Code Excited Linear Prediction - CELP speech production model; Analysis-by-synthesis; Generic CELP encoders and decoders; Excitation codebook search – state-save method, zero-input zero-state method; CELP based on adaptive codebook, Adaptive Codebook search; Low Delay CELP and algebraic CELP.

Speech Coding Standards - An overview of ITU-T G.726, G.728 and G.729standards

Text/Reference Books:

1. “Digital Speech” by A.M.Kondoz, Second Edition (Wiley Students‟ Edition), 2004.

2. “Speech Coding Algorithms: Foundation and Evolution of Standardized Coders”, W.C. Chu, WileyInter science, 2003.

DEEE-805	High Voltage Engineering	L-T-P-C: 3-1-0-4
Course Outcomes: At the end of this course students will demonstrate the ability to		
CO1	Understand the basic physics related to various breakdown processes in solid, liquid and gaseous insulating materials	
CO2	Exhibit knowledge of generation and measurement of D. C., A.C., and Impulse voltages	
CO3	Comprehend tests on H. V. equipment and on insulating materials, as per the standards.	
CO4	Analyse how over-voltages arise in a power system	
C05	Understand protection against these over-voltages	

Unit 1:

Breakdown in Gases (8 Hours) Ionization processes and de-ionization processes, Types of Discharge, Gases as insulating materials, Breakdown in Uniform gap, non-uniform gaps, Townsend's theory, Streamer mechanism, Corona discharge

Unit 2:

Breakdown in liquid and solid Insulating materials (7 Hours) Breakdown in pure and commercial liquids, Solid dielectrics and composite dielectrics, intrinsic breakdown, electromechanical breakdown and thermal breakdown, Partial discharge, applications of insulating materials.

Unit 3:

Generation of High Voltages (7 Hours) Generation of high voltages, generation of high D. C. and A.C. voltages, generation of impulse voltages, generation of impulse currents, tripping and control of impulse generators.

Unit 4:

Measurements of High Voltages and Currents (7 Hours) Peak voltage, impulse voltage and high direct current measurement method, cathode ray oscillographs for impulse voltage and current measurement, measurement of dielectric constant and loss factor, partial discharge measurements.

Unit 5:

Lightning and Switching Over-voltages (7 Hours) Charge formation in clouds, Stepped leader, Dart leader, Lightning Surges. Switching over-voltages, Protection against over-voltages, Surge diverters, Surge modifiers.

Unit 6:

High Voltage Testing of Electrical Apparatus and High Voltage Laboratories (7 Hours) Various standards for HV Testing of electrical apparatus, IS, IEC standards, Testing of insulators and bushings, testing of isolators and circuit breakers, testing of cables, power transformers and some

high voltage equipment, High voltage laboratory layout, indoor and outdoor laboratories, testing facility requirements, safety precautions in H. V. Labs.

Text/Reference Books

1. M. S. Naidu and V. Kamaraju, “High Voltage Engineering”, McGraw Hill Education, 2013.
2. C. L. Wadhwa, “High Voltage Engineering”, New Age International Publishers, 2007.
3. D. V. Razevig (Translated by Dr. M. P. Chourasia), “High Voltage Engineering Fundamentals”, Khanna Publishers, 1993.
4. E. Kuffel, W. S. Zaengl and J. Kuffel, “High Voltage Engineering Fundamentals”, Newnes Publication, 2000.
5. R. Arora and W. Mosch “High Voltage and Electrical Insulation Engineering”, John Wiley & Sons, 2011
6. Various IS standards for HV Laboratory Techniques and Testing

Undergraduate Degree Courses in Engineering & Technology

BACHELOR OF ENGINEERING (MECHANICAL ENGINEERING)

General, Course Structure & Scheme

&

Semester-Wise Credit Distribution

A. Definition of Credit:

1 Hr. Lecture (L) per week	1 credit
1 Hr. Tutorial (T) per week	1 credit
1 Hr. Practical (P) per week 2 Hours Practical (Lab)/week	0.5 credits 1 credit

B. **Structure of Undergraduate Engineering program:**

S. No.	Category	Suggested Breakup of Credits (Total 160)
1.	Basic Science Courses (BSC)	20
2.	Engineering Science Courses (ESC)	30
3.	Humanities, Social Science and Management Courses (HSMC)	10
4.	Professional Core Courses (PCC)	60
5.	Professional Elective Courses (PEC)	18
6.	Open Elective Courses (OEC)	14
7.	Seminar	2
8.	Project	10
9.	Internships in industry	8
10.	Mandatory Courses (MC)	NC
	Total Credits	172

C. Course code and definition:

Course code	**Definitions**
BSC	Basic Science Courses
ESC	Engineering Science Courses
HSMC	Humanities and Social Sciences including Management courses
PCC	Professional core courses
PEC	Professional Elective courses
OEC	Open Elective courses
LC	Laboratory course
MC	Mandatory courses

**Minor variation is allowed as per need of the respective disciplines.*

Mechanical Engineering

Table: Structure of B.E. Program
Calculation Table of Credits as per AICTE Norms

S. No.	Courses		Credits							Actual Credits
		Total Credits	I&II	III	IV	V	VI	VII	VIII	
1.	Basic Science Courses (BSC)	20	17	4						21
2.	Engineering Science Courses (ESC)	30	19	8	4					31
3.	Humanities, Social Science and Management Courses (HSMC)	10	4			3	3			10
4.	Professional Core Courses (PCC)	60		8	18	10	13	6	7	62
5.	Professional Elective Courses (PEC)	18				4	3	4	4	15
6.	Open Elective Courses (OEC)	14				3	3	4	4	14
7.	Seminar	2						2		2
8.	Project	10						3	7	10
9.	Internships in industry	8		2		2		3		7
10	Mandatory Courses (MC)	NC								
	Total Credits	172	40	22	22	22	22	22	22	172

Institute of Engineering & Technology, Dr. Bhimrao Ambedkar University, Khandari Campus, Agra

B.E. II Year (Mechanical Engineering) Third Semester

Course Structure & Evaluation Scheme

S. No.	Course Category	Course Code	Course Title	Contact hrs/Week			Sessional Marks			End Semester Marks		Total	Credit
				L	T	P	CT	TA	Total	TE	PE		
1	BSC	BSC301	MATH III	3	1	0	30	10	40	60	-	100	4
2	PCC	BME301	STRENGTH OF MATERIAL	3	1	0	30	10	40	60	-	100	4
3	ESC	BME302	MATERIAL SCIENCE	3	0	0	30	10	40	60	-	100	3
4	PCC	BME303	ENGINEERING THERMODYNAMICS	3	1	0	30	10	40	60	-	100	4
5	ESC	BME304	MACHINE DRAWING	2	0	0	30	10	40	60	-	100	2
6	MC	BMC301	ENVIRONMENTAL & ECOLOGY	2	0	0	30	10	40	60	-	100	0
7	ESC	BME352	MATERIAL SCIENCE LAB	0	0	2	20	20	40	-	60	100	1
8	ESC	BME354	MACHINE DRAWING LAB	0	0	4	20	20	40	-	60	100	2
9	Project (Internship)	BME355	MINI PROJECT/ INTERNSHIP ASSESMENT*	0	0	2	-	-	100	-		100	2
			Total									900	22

* The Mini Project or Internship (3-4 weeks) conducted during summer break after II semester & will be assessed during III semester.

Institute of Engineering & Technology, Dr. Bhimrao Ambedkar University, Khandari Campus, Agra

B.E. II Year (Mechanical Engineering) Fourth Semester

Course Structure & Evaluation Scheme

S. No.	Course Category	Course Code	Course Title	Contact hrs/Week			Sessional Marks			End Semester Marks		Total	Credit
				L	T	P	CT	TA	Total	TE	PE		
1	ESC	BME401	MEASUREMENT & METROLOGY	3	0	0	30	10	40	60	-	100	3
2	PCC	BME402	ENGINEERING FLUID MECHANICS	3	1	0	30	10	40	60	-	100	4
3	PCC	BME403	MANUFACTURING SCIENCE-I	3	0	0	30	10	40	60	-	100	3
4	PCC	BME404	THEORY OF MACHINES-I	3	1	0	30	10	40	60	-	100	4
5	PCC	BME405	APPLIED THERMODYNAMICS	3	1	0	30	10	40	60	-	100	4
6	MC	BMC402	HUMAN VALUES AND PROFESSIONAL ETHICS	2	0	0	30	10	40	60	-	100	0
7	ESC	BME451	MEASUREMENT & METROLOGY LAB	0	0	2	20	20	40	-	60	100	1
8	PCC	BME452	ENGINEERING FLUID MECHANICS LAB	0	0	2	20	20	40	-	60	100	1
9	PCC	BME453	MANUFACTURING SCIENCE I LAB	0	0	2	20	20	40	-	60	100	1
10	PCC	BME455	APPLIED THERMODYNAMICS LAB	0	0	2	20	20	40	-	60	100	1
			Total									1000	22

B.E. III Year (Mechanical Engineering) Fifth Semester

Course Structure & Evaluation Scheme

S. No.	Course Category	Course Code	Course Title	Contact hrs/Week			Sessional Marks			End Semester Marks		Total	Credit
				L	T	P	CT	TA	Total	TE	PE		
1	PCC	BME501	INTERNAL COMBUSTION ENGINE	3	1	0	30	10	40	60	-	100	4
2	PCC	BME502	THEORY OF MACHINES-II	3	1	0	30	10	40	60	-	100	4
3	DE-ME	DE-ME501	DEPARTMENTAL ELECTIVE I	3	1	0	30	10	40	60	-	100	4
4	OE-ME	OE-ME501	OPEN ELECTIVE I	3	0	0	30	10	40	60	-	100	3
5	HS	BHSM-501	INDUSTRIAL MANAGEMENT	3	0	0	30	10	40	60	-	100	3
6	MC	BMC501	Occupational Health and Safety	3	0	0	30	10	40	60	-	100	0
6	PCC	BME551	INTERNAL COMBUSTION ENGINE LAB	0	0	2	20	20	40	-	60	100	1
7	PCC	BME552	THEORY OF MACHINES LAB	0	0	2	20	20	40	-	60	100	1
8	Project (Internship)	BME553	INTERNSHIP	0	0	4	-	-	100	-	-	100	2
			Total									800	22

B.E. III Year (Mechanical Engineering) Sixth Semester

Course Structure & Evaluation Scheme

S. No.	Course Category	Course Code	Course Title	Contact hrs/Week			Sessional Marks			End Semester Marks		Total	Credit
				L	T	P	CT	TA	Total	TE	PE		
1	PCC	BME601	DESIGN OF MACHINE ELEMENTS	3	1	0	30	10	40	60	-	100	4
2	PCC	BME602	HEAT AND MASS TRANSFER	3	1	0	30	10	40	60	-	100	4
3	PCC	BME603	AUTOMOBILE ENGINEERING	3	0	0	30	10	40	60	-	100	3
4	DE-ME	DE-ME 601	DEPARTMENTAL ELECTIVE II	3	0	0	30	10	40	60	-	100	3
5	OE-ME	OE-ME-601	OPEN ELECTIVE II	3	0	0	30	10	40	60	-	100	3
6	HSMC	BHSM-601	ECONOMICS FOR INDUSTRY	3	0	0	30	10	40	60	-	100	3
7	PCC	BME652	HEAT AND MASS TRANSFER LAB	0	0	2	20	20	40	-	60	100	1
8	PCC	BME653	AUTOMOBILE ENGINEERING LAB	0	0	2	20	20	40	-	60	100	1
			Total									800	22

Institute of Engineering & Technology, Dr. Bhimrao Ambedkar University, Khandari Campus, Agra

B.E. IV Year (Mechanical Engineering) Seventh Semester

Course Structure & Evaluation Scheme

S. No.	Course Category	Course Code	Course Title	Contact hrs/Week			Sessional Marks			End Semester Marks		Total	Credit
				L	T	P	CT	TA	Total	TE	PE		
1	PCC	BME 701	MECHANICAL VIBRATION	3	0	0	30	10	40	60	-	100	3
2	PCC	BME 702	ADVANCED WELDING TECHNOLOGY	2	0	0	30	10	40	60	-	100	2
3	DE-ME	DE-ME 701	DEPARTMENTAL ELECTIVE III	3	0	0	30	10	40	60	-	100	3
4	OE-ME	OE-ME701	OPEN ELECTIVE III	3	1	0	30	10	40	60	-	100	4
5	PCC	BME 751	MECHANICAL VIBRATION LAB	0	0	2	20	20	40	-	60	100	1
6	DE-ME	DE-ME 751	DEPARTMENTAL ELECTIVE III LAB	0	0	2	20	20	40	-	60	100	1
8	Project (Internship)	BME752	INTERNSHIP	0	0	4	20	20	40	-	60	100	3
9	SEMINAR	BME753	SEMINAR	0	0	4	20	20	40	-	60	100	2
10	Project (Internship)	BME754*	MINOR PROJECT	0	0	6	-	150	150	-	150	300	3
			Total									1100	22

***Internal evaluation**

B.E. IV Year (Mechanical Engineering) Eight Semester

Course Structure & Evaluation Scheme

S. No.	Course Category	Course Code	Course Title	Contact hrs/Week			Sessional Marks			End Semester Marks		Total	Credit
				L	T	P	CT	TA	Total	TE	PE		
1	PCC	BME801	Computer Aided Design and Manufacturing	3	0	0	30	10	40	60	-	100	3
2	PCC	BME802	THERMAL TURBO MACHINES	3	0	0	30	10	40	60	-	100	3
3	DE-ME	DE-ME 801	DEPARTMENTAL ELECTIVE IV	3	1	0	30	10	40	60	-	100	4
4	OE-ME	OE-ME 801	OPEN ELECTIVE IV	3	1	0	30	10	40	60	-	100	4
5	PCC	BME851	Computer Aided Design and Manufacturing Lab	0	0	2	20	20	40	-	60	100	1
6	Project (Internship)	BME852*	INDUSTRIAL BASED PROJECT	0	0	20	-	150	150	-	150	300	7
			Total									800	22

*External evaluation

DEPARTMENTAL ELECTIVE ME I **4[3-0-2]**

Sr. No.	Subject Code	Course Title	L	T	P	Credits
1.	DE-ME-501	Manufacturing Science –II	3	1	0	4
2.	DE-ME-502	Rapid Prototyping & Rapid Tooling	3	1	0	4
3.	DE-ME-503	Tribology	3	1	0	4

OPEN ELECTIVE ME I **3[3-0-0]**

Sr. No.	Subject Code	Course Title	L	T	P	Credits
1.	OE-ME-501	Industrial engineering & Automation	3	0	0	3
2.	OE-ME-502	Total Quality Management	3	0	0	3
3.	OE-ME-503	Production Planning and Control	3	0	0	3
4.	OE-ME-504	Value Engineering	3	0	0	3

DEPARTMENTAL ELECTIVE ME II **3[3-0-0]**

Sr. No.	Subject Code	Course Title	L	T	P	Credits
1.	DE-ME-601	Un Conventional Manufacturing	3	0	0	3
2.	DE-ME-602	Experimental Stress Analysis	3	0	0	3
3.	DE-ME-603	Reliability and Maintenance Engineering	3	0	0	3
4.	DE-ME-604	Additive Manufacturing	3	0	0	3

OPEN ELECTIVE ME II **3[3-0-0]**

Sr. No.	Subject Code	Course Title	L	T	P	Credits
1.	OE-ME-601	Composite Materials	3	0	0	3
2	OE-ME-602	Entrepreneurship	3	0	0	3
3	OE-ME-603	Mechanical System Design	3	0	0	3
4.	OE-ME-604	Product Design and Development	3	0	0	3

DEPARTMENTAL ELECTIVE ME III **4[3-0-2]**

Sr. No.	Subject Code	Course Title	L	T	P	Credits
1.	DE-ME-701	Refrigeration and Air Conditioning	3	0	2	4
2.	DE-ME-702	Design & Analysis of Heat Exchangers	3	0	2	4

OPEN ELECTIVE ME III **4[3-1-0]**

Sr. No.	Subject Code	Course Title	L	T	P	Credits
1.	OE-ME-701	Non-Conventional Energy Resources	3	1	0	4
2	OE-ME-702	Nanotechnology	3	1	0	4
3	OE-ME-703	Non-Destructive Evaluation	3	1	0	4
4.	OE-ME-704	Introduction to Mechanical Micro Machining	3	1	0	4

DEPARTMENTAL ELECTIVE ME IV **4[3-1-0]**

Sr. No.	Subject Code	Course Title	L	T	P	Credits
1.	DE-ME-801	Reverse Engineering	3	1	0	4
2.	DE-ME-802	Computational Fluid Dynamics	3	1	0	4

OPEN ELECTIVE ME IV **4[3-1-0]**

Sr. No.	Subject Code	Course Title	L	T	P	Credits
1.	OE-ME-801	Power Plant Engineering	3	1	0	4
2	OE-ME-802	Optimization Methods in Engineering	3	1	0	4
3.	OE-ME-803	Fracture Mechanics	3	1	0	4
4.	OE-ME-804	Machine Tool Design	3	1	0	4

Mathematics III (BSC-301)

III SEMESTER (ECE, CSE, EE, ME, CE)

L T P C

3 1 0 4

Prerequisite: Basic knowledge of elementary Mathematics.

Course Outcomes (COs):

After completing this course a student will be able to:

1. Solve the Fourier Transform of function.
2. Compute poles & zeros.
3. Evaluate the real & complex integrals with the help of Cauchy's Residue Theorem.
4. Utilize curve fitting techniques for data representations and computation in engineering analysis.
5. Employee the principle of linear regression and correlation, translate real word problems into probability models, Use Binomial, Poisson & Normal Distribution to solve statistical problems.

Course Content:

Unit I

Fourier Transform: Fourier integral, conditions of convergence, Fourier sine and cosine integrals, complex form, applications, Inversion formula for Fourier transform, operational properties. Discrete and Fast Fourier transform. Applications of Fourier transform to solve boundary value problems.

Unit II

Functions of a Complex Variable and Conformal mapping: Limit, Continuity, Differentiability and Analyticity of functions of a complex variable, Cauchy-Riemann equations, Harmonic functions, Complex functions as mappings, Linear Transformation, Inverse transformation, Bilinear Transformations, Conformal Mapping & applications.

Unit III

Integration of Complex Functions: Contour integrals and evaluations, Cauchy's Theorem, Cauchy's Integral Formulae, Liouville's theorem, Convergence of power series, Taylor series, Laurent series, Zeros and Singularities of a complex function, Residues and Residue theorem, Evaluation of definite and improper integrals.

Unit IV

Curve- Fitting & Probability: Curve-fitting: method of least- squares, Normal equations, Normal equation in case of straight line, Fitting a straight line, Polynomial, non-linear and exponential

curves, Change of origin. Probability: Basics of probability, random variables, Expectation, Baye's theorem and probability distributions, Binomial, Poisson and Normal distributions.

Unit V

Statistical Methods: Sampling Theory, Parameters of Statistics, Tests of hypothesis and significance, z-test, t-test,$\chi 2$- test ,Goodness of fit test, Time series analysis, Index numbers, Quality control chart and acceptance sampling, Introduction to design of experiments, Forecasting models.

Text Books

1. R.K. Jain & S.R.K. Iyengar; Advanced Engineering Mathematics, Narosa Publishing House, 2002.
2. Erwin Kreyszig; Advanced Engineering Mathematics, John Wiley & Sons, 1962.
3. R.V. Churchill and J.L. Brown, Complex Variables and Applications, McGraw Hill, 1990.
4. B.S.Grewal, Higher Engineering Mathematics, Khanna Publisher, 2005.
5. J.H. Mathews and R.W. Howell, Complex analysis for Mathematics and Engineering, 3rd Ed. Narosa, 1998.

Strength of Materials (BME-301)

L T P C

3 1 0 4

Prerequisite: Students must have knowledge of engineering mechanics basic engineering applications.

Course Outcomes (COs):

After completing this course a student will be able to:

1. Compute the fundamentals of stress and strain concepts in compound loading condition and demonstrate an understanding of the applied mechanics theory.
2. Calculate the stresses and strains associated with thin and thick cylinder.
3. Analyzing the problems of springs subjected to various actions and Evaluating stresses in columns.
4. Calculate stresses and deformations in beams subjected to different loading and Estimate the effect of torsion in shafts.
5. Demonstrate stress and deflection in unsymmetrical bending and Curved Beams, determination of shear center.

Course Content:

Unit I

Compound stress and strains: Introduction, normal stress and strain, shear stress and strain, stresses on inclines sections, strain energy, impact loads and stresses, state of plane stress, principal stress and strain, maximum shear stress, Mohr's stress circle, three dimensional states of stress & strain, equilibrium equations, generalized Hook's law, theories of failure.

Unit II

Thin cylinders & spheres: Introduction, difference between thin walled and thick walled pressure vessels, thin walled spheres and cylinders, hoop and axial stresses and strain, volumetric strain.

Thick cylinders: Radial, axial and circumferential stresses in thick cylinders subjected to internal or external pressures, compound cylinders, stresses in rotating shaft and cylinders, stresses due to interference fits.

Unit III

Helical and Leaf Springs: Deflection of springs by energy method, helical springs under axial load and under axial twist (respectively for circular and square cross sections) axial load and twisting moment acting simultaneously both for open and closed coiled springs, laminated springs.

Columns and Struts: Buckling and stability, slenderness ratio, combined bending and direct stress, middle third and middle quarter rules, struts with different end conditions, Euler's theory for pin

ended columns, effect of end conditions on column buckling, Ranking Gordon formulae, examples of columns in mechanical equipment and machines.

Unit IV

Stresses in Beams: Pure Bending**,** normal stresses in beams, shear stresses in beams due to transverse and axial loads, composite beams.

Deflection of Beams: Equation of elastic curve, cantilever and simply supported beams, Macaulay's method, area moment method, fixed and continuous beams, Castigliano's Theorem

Torsion: Torsion combined bending & torsion of solid & hollow shafts, torsion of thin walled tubes.

Unit V

Unsymmetrical Bending: Properties of beam cross-section slope of neutral axis, stress and deflection in unsymmetrical bending, determination of shear center and flexural axis (for symmetry about both axis and about one axis) for I-section and channel section.

Curved Beams: Bending of beams with large initial curvature, position of neutral axis for rectangular, trapezoidal and circular cross sections, stress in crane hooks, stress in circular rings subjected to tension or compression.

Textbooks:

1. Strength of Materials by R. K. Bansal.
2. Strength of Materials by R.K. Rajput

Reference books:

1. Engineering Mechanics by Irving H. Shames, Prentice-Hall.
2. Mechanics of Materials by E.P.Popov, PHI.
3. Strength of Materials by Ryder.
4. Mechanics of Material by Gere & Timoshenko.
5. Engineering Mechanics by A. Nelson.
6. Engineering Mechanics by U.C. Jindal.
7. Engineering Mechanics Statics by J.L. Meriam & L. G. Kraige.

Materials Science (BME-302)

L T P C

3 0 2 4

Prerequisite: Fundamental knowledge of Intermediate level physics and chemistry.

Course Outcomes (COs):

After completing this course a student will be able to:

1. Analyze the Structure of materials at different levels, basic concepts of crystalline materials like unit cell, FCC, BCC, HCP, APF (Atomic Packing Factor), Co-ordination Number etc.
2. Understand concept of mechanical behavior of materials and calculations of same using appropriate equations.
3. Explain the concept of phase & phase diagram & understand the basic terminologies associated with metallurgy. Construction and identification of phase diagrams and reactions.
4. Understand and suggest the heat treatment process & types. Significance of properties Vs microstructure. Surface hardening & its types. Introduce the concept of hardenability & demonstrate the test used to find hardenability of steels.
5. Explain features, classification, applications of newer class materials like smart materials, piezoelectric materials, biomaterials, composite materials etc.

Course Content:

Unit I

Introduction: Historical perspective, importance of materials. Brief review of modern & atomic concepts in Physics and Chemistry. Atomic models, Periodic table, Chemical bondings.

Crystallography and Imperfections: Concept of unit cell space lattice, Bravais lattices, common crystal structures, Atomic packing factor and density. Miller indices. X-ray crystallography techniques. Imperfections, Defects & Dislocations in solids.

Unit II

Mechanical properties and Testing: Stress strain diagram, Ductile & brittle material, Stress VS strength. Toughness, Hardness, Fracture, Fatigue and Creep. Testing's such as Strength testing's', Hardness testing, Impact testing's, Fatigue testing Creep testing, Nondestructive testing (NDT).

Microstructural Exam: Microscope principle and methods. Preparation of samples and Microstructure exam and grain size determination. Comparative study of microstructure of various metals & alloys such as Mild steel, CI, Brass.

Phase Diagram and Equilibrium Diagram: Unitary and Binary diagrams, Phase rules. Types of equilibrium diagrams: Solid solution type, eutectic type and combination type. Iron-carbon equilibrium diagram.

Unit III

Ferrous materials: Iron and steel manufacture, furnaces. Various types of carbon steels, alloy steels and cast irons, its properties and uses.

Heat Treatment: Various types of heat treatment such as Annealing, Normalizing, Quenching, Tempering and Case hardening. Time Temperature Transformation (TTT) diagrams.

Non-Ferrous metals and alloys: Non-ferrous metals such as Cu, Al, Zn, Cr, Ni etc. and its applications. Various type Brass, Bronze, bearing materials, its properties and uses. Aluminum alloys such as Duralumin. Other advanced materials/alloys.

Unit IV

Magnetic properties: Concept of magnetism - Dia, para, ferro Hysteresis. Soft and hard magnetic materials, Magnetic storages.

Electric properties: Energy band concept of conductor, insulator and semi-conductor. Intrinsic & extrinsic semi-conductors. P-n junction and transistors. Basic devices and its application. Diffusion of Solid. Super conductivity and its applications. Messier effect. Type I & I superconductors. High temperature superconductors.

Unit V

Ceramics: Structure types and properties and applications of ceramics. Mechanical/Electrical behaviour and processing of Ceramics.

Plastics: Various types of polymers/plastics and its applications. Mechanical behaviors and processing of plastics. Future of plastics.

Other materials: Brief description of other material such as optical and thermal materials concrete, Composite Materials and its uses.

Performance of materials in service: Brief theoretical consideration of Fracture, Fatigue, and Corrosion and its control.

Text books:

1. Material Science & Engineering by W.D. Callister, Jr., Addison-Wesley Pub.Co.
2. Engineering Materials, Vol. I &II by Ashby &Jones, Pergemon Press.
3. Material Science by V Raghvan, Pretice Hall of India.
4. Material Science by K M Gupta.

Reference books:

1. Elements of Material Science & Engineering by Van Vlack, John Wiley & Sons.
2. Material Science by V. Raghvan, Prentice Hall of India.
3. Elements of Material Science & Engineering by Van Vlash John Wiley & Sons..
4. Science of Materials Engineering by Srivastava, Srinivasan Newage.

Materials Science Lab (BME-352)

Course Outcomes (COs):

After completing this course a student will be able to:

1. Prepare formal laboratory reports describing the results of experiments;
2. Operate basic instruments in materials science and engineering;
3. Interpret the data from the experiments.
4. Relate properties to microstructure.
5. Understand various crystal structures and relationship to properties
6. Select metals and alloys for industrial applications
7. Understanding metals and their use in industries
8. Understanding heat treatment procedures and the change of properties
9. Improving material properties by different heat treatment processes.

Any 8 experiments out of following:

1. To identify different kind of materials by observation.
2. To prepare specimen for metallographic examination.
3. To perform Jominy End Quench Test to determine hardenability of steel.
4. Specimen preparation for micro structural examination-cutting, grinding, polishing, etching.
5. Comparative study of microstructures of different given specimens (mild steel, gray C.I., brass, copper etc.)
6. Heat treatment experiments such as annealing, normalizing, quenching, casehardening and comparison of hardness before and after.
7. Study of HCP FCC and BCC.
8. Study of microstructure of welded component and HAZ. Macro & Micro Examination.
9. To determine Rockwell Hardness and Brinell Hardness of given test specimen.
10. To perform tensile test on given specimen using UTM.
11. To perform Compression Test on given specimen using UTM.
12. To perform Izod & Charpy Impact test.
13. To perform Torsion test on given specimen.
14. To perform fatigue test on given specimen.

Engineering Thermodynamics (BME-303)

L T P C

3 1 0 4

Prerequisite: Physics of Class XII

Course Outcomes (COs):

After completing this course a student will be able to:

1. Understand the role of the internal energy, enthalpy, entropy, temperature, pressure and specific volume thermodynamic properties and illustrate laws of thermodynamics state and apply the first law of thermodynamics for closed and open systems.
2. Understand second law of thermodynamics and concepts of entropy and apply the concept to solve entropy problems.
3. Distinguish between ideal gas and pure substance and calculate thermodynamics properties using tables of thermodynamics properties and ability to solve problems based on Rankine and Brayton cycle.
4. Understand concept of irreversibility and second law efficiency and establish thermodynamic relation among various equation.
5. Estimate Stoichiometric air required for combustion and exhaust gas analysis.

Course Content:

Unit I

Fundamental Concepts and Definitions: Introduction and definition of thermodynamics, Dimensions and units, Microscopic and Macroscopic approaches, Systems, surroundings and universe, Concept of continuum, Control system boundary, control volume and control surface, Properties and state, Thermodynamic properties, Pressure and its measurement, Thermodynamic path, process and cycle, Thermodynamic equilibrium, Reversibility and irreversibility, Quasistatic process, Energy and its forms, Work and heat, Gas laws, Ideal gas.

Zeroth law of thermodynamics: Zeroth law of thermodynamics, Temperature and its measurement, Temperature scales.

First law of thermodynamics: Thermodynamic definition of work, Thermodynamic processes, Calculation of work in various processes and sign convention, Non-flow work and flow work, Joules' experiment, First law of thermodynamics, Internal energy and enthalpy, First law of thermodynamics applied to open systems, Steady flow systems and their analysis, Steady flow energy equation, Boilers, Condensers, Turbine, Throttling process, Pumps etc. First law analysis for closed system (non flow processes), Analysis of unsteady processes such as filling and evacuation of vessels with and without heat transfer, Limitations of first law of thermodynamics, PMM-I.

Unit II

Second law of Thermodynamics: Devices converting heat to work, Thermal reservoir, Heat Source, Heat Sink, Heat engines, Efficiency, Devices converting work to heat, Heat pump, refrigerator, Coefficient of Performance, Reversed heat engine, Kelvin Planck statement of second law of thermodynamics, Clausius statement of second law of thermodynamics, Equivalence of two statements of second law of thermodynamics, Reversible and irreversible processes, Carnot cycle and Carnot engine, Carnot theorem and it's corollaries, thermodynamic temperature scale, PMM-II.

Entropy: Clausius inequality, Concept of Entropy, Entropy change in different thermodynamic processes, Tds equation, Principle of entropy increase, T-S diagram, Statement of the third law of thermodynamics.

Unit III

Properties of steam and thermodynamics cycles: Pure substance, Property of steam, Triple point, Critical point, Sub-cooled liquid, Saturation states, Superheated states, Phase transformation process of water, Graphical representation of pressure, volume and temperature, P-T & P-V diagrams, T-S and H-S diagrams, use of property diagram, Steam-Tables &Mollier charts, Dryness factor and it's measurement, processes involving steam in closed and open systems. Simple Rankine cycle, Brayton cycle.

Unit IV

Availability and Irreversibility: Available and unavailable energy, Availability and Irreversibility, Second law efficiency, Helmholtz & Gibb's function, Availability analysis.

Thermodynamic relations: Mathematical conditions for exact differentials. Maxwell Relations, Clapeyron Equation, Joule-Thompson coefficient and Inversion curve. Coefficient of volume expansion, Adiabatic & Isothermal compressibility; Real gas, Law of corresponding states, Dalton's law, Amagat's law, Property of mixture of gases.

Unit V

Fuels and Combustion: Combustion analysis, Heating Values and its measurement, Air requirement, Air/Fuel ratio, Standard heat of Reaction and effect of temperature on standard heat of reaction, heat of formation, Chemical Equilibrium, adiabatic flame temperature, Exhaust gas analysis.

Textbooks:

1. Basic and Applied Thermodynamics by PK Nag, MCGRAW HILL INDIA.
2. Fundamentals of Thermodynamics by Sonntag, Van Wylen, Borgnakke, JohnWiley& Sons
3. Thermodynamics : An engineering approach by Cengel& Boles, Mc Graw Hill

Reference books:

1. Engineering Thermodynamics by Jones and Dugans, PHI Learning Pvt. Ltd.
2. Thermodynamics by J.P. Holman, McGraw Hill.

Machine Drawing (BME-304)

L T P C

2 0 4 4

Prerequisite: Basic knowledge of Engineering Graphics and Design.

Course Outcomes (COs):

After completing this course a student will be able to:

1. Understand principles of orthographic projections for machine drawing.
2. To draw the projections of machine elements including keys, couplings, cotters, riveted, bolted and welded joints.
3. To draw the assembled view using drawings of machine components and Engines.
4. To free hand sketches of machine elements.
5. Understand detailed Assembly drawings of Ball bearing, shaft, crane hook, Plummer block, tailstock, engine block assembly. Remembering the concepts Computer aided drawing of machine components.

Course Content:

Unit I

Review of engineering graphics, IS & ISO codes, fit and tolerance, Surface Finish , Design of Simple machine elements; (Threaded fasteners, locking arrangements, Guides) of some assemblies.

Unit II

Riveted Joints: Introduction, Rivets and Riveting, Rivet Heads, Classification of Riveted Joints and Welded Joint. **Keys and Cotters:** Keys, Cotter joints. Shaft and Couplings.

Unit III

Screwed (Threaded) fasteners: Introduction, Screw thread nomenclature, Forms of threads, Thread series, Thread designation. Representation of threads, Bolted joints, locking arrangements for nuts, Foundation bolts.

Unit IV

Free hand sketching: Introduction, Need for free hand sketching, Free hand of sketching of some threaded fasteners and simple machine components.

Unit V

Assembly drawing & part list; Ball bearing, shaft, crane hook, Plummer block, stop valve, tailstock, engine block assembly.

Computer aided drawing of machine components, Valves etc.'

A drawing Project on reverse engineering.

Textbooks:

1. A Text Book of Machine Drawing by Lakshmi narayanan .V. & Marhur, M. L Jain Brothers' N. Delhi.

2. Design of Machine Elements by V.B. Bhandari TMH N. Delhi.

Reference Books:

1. Machine Drawing by Siddheswar, N. Kannaiah. P. & Sastry V.V.S TMH N. Delhi.

2. Mechanical Engg. Design by Shigley & Mische Mc Graw Hill.

Machine Drawing (BME-354)

Course Outcomes (COs):

After completing this course a student will be able to:

1. Prepare different types of line and dimensioning.
2. Understand of orthogonal projection and isometric projection.
3. Analyze the concept of different types of fasteners.
4. Understand and draw different types of machine elements.
5. Analyze the different types of Assembly.

List of Experiments:

1. Drawing sheet (1 sheet) – Scales, Types of Lines, Section Line, Dimensioning.
2. Drawing sheet (1 sheet) – Orthographic Projection in First and Third Angle, Isometric Projection.
3. Drawing sheet (2 sheet) –Screwed Fasteners.
4. Drawing sheet (1 sheet) – Keys and Cotters and Pin joints.
5. Drawing sheet (1 sheet) – Shaft Coupling.
6. Drawing sheet (1 sheet) – Riveted joint.
7. Drawing sheet (3 sheet) – Assembly Drawing.

Environment and Ecology (MC-301/MC-401)

L T P C

2 0 0 0

Prerequisite: Basic knowledge College Geography.

Course Outcomes (COs):

After completing this course a student will be able to:

1. Understanding of the importance of ecosystem and biodiversity and natural resources for maintaining ecological balance.
2. Analyze human impacts on various aspects of the environment and social issue related to sustainable development.
3. Identifying sources and effects of environmental pollution. Develop the methods for control of environmental pollution and hazards due to engineering/technological activities.
4. Aware of important acts and laws in respect of environment and EIA process.

Course Content:

Unit I

Nature of Environment Introduction to Environmental Science: Definition and scope and need for public awareness Ecosystems Concept, structure and functions, restoration of damaged ecosystems Biodiversity – Definition, description at national and global level, threats and conservation Natural Resources - Renewable and non-renewable and their equitable use for sustainability, Material cycles – carbon, nitrogen and sulphur cycle. Conventional and Non-conventional Energy Sources – fossil fuel-based, hydroelectric, wind, -nuclear and solar energy, biomass, biodiesel, hydrogen as an alternative fuel

Unit II

Impact of Human Activity on Environment Human Population and Environment: Population growth, population explosion and migration; Impact of farming, housing, mining, transportation and industrial growth Social Issues Related to Environment– Sustainable development, urban problems (related to water and energy conservation and waste management), resettlement and rehabilitation Environmental ethics

Unit III

Environmental Changes and Human Health Environmental Pollution: Definition, causes and effects, control measures for water, air, soil, marine, land, noise, thermal pollution, Climate change– Greenhouse effect and global warming, acid rain, ozone layer formation and depletion Impact on human health – water and air borne diseases, diseases induced by residual impurities in drinking water (fluoride and arsenic); Toxic wastes and carcinogens; Nuclear hazards

Unit IV

Environmental Protection through Assessment and Education Indicators and Impact Assessment: Bio-indicators, Natural disasters and disaster management, Impact assessment through inventorying and monitoring Environmental Protection– Role of individuals, organizations and government in pollution control Laws, Conventions and Treaties–National legislation, issues in the enforcement of environmental legislation, initiatives by non- governmental organizations, global efforts in environmental protection Environmental education–women and value education Recommended.

Text Books:

1. Environmental Studies, J Krishnawamy, R J Ranjit Daniels, Wiley India.
2. Environment and Ecology, R K Khandal, 978-81-265-4277-2, Wiley India.
3. Textbook of Environment Ecology, Singh, Acme Learning.
4. Environmental Studies, R Rajagopalan, 978-0195673937, Oxford University Press.

Reference Books:

1. Environmental Science, Bernard J. Nebel, Richard T. Right, 9780132854467, Prentice Hall Professional 1993.
2. Environmental Science, 8th Ed ISV, Botkin and Keller, 9788126534142, Wiley India.
3. Textbook of Environmental Science and Technology, M. Anjireddy, BS Publications.
4. Environmental Studies, Soli. J Arceivala, Shyam, R Asolekar, 9781259006050, McGrawHill India, 2012.
5. Environmental Studies, D.L. Manjunath, 9788131709122 Pearson Education India, 2007.
6. Perspective in Environmental Studies, Kaushik, New Age International.
7. Environmental Studies, B. Joseph, 2nd Ed, 978-0070648134, Tata McGraw Hill.

Measurement and Metrology (BME-401)

L T P C

3 0 2 4

Prerequisite: Basic knowledge of Engineering physics, Fundamental Concept of Workshop Practice, Engineering thermodynamics etc.

Course Outcomes (COs):

After completing this course a student will be able to:

1. Ability to understand the basic concepts of measurement by learning about different measuring systems, different sensor and transducers and different signal transmission and processing devices.
2. Ability to understand the working principle of different measuring devices for time, pressure, force and temperature measurement.
3. Ability to understand the concept of limit, fit and tolerance for applying it for solving the numerical problems, and understand the concept of comparators.
4. Ability to understand the concept of geometric forms and use of different tools for measurement of geometric forms, measurement related to thread and surface texture.
5. Ability to understand the concept of control system and study of different types of controllers.

Course Content:

Unit I

Mechanical Measurements: Introduction to measurement and measuring instruments, Generalized measuring system and functional elements, units of measurement, static and dynamic performance characteristics of measurement devices, calibration, concept of error, sources of error, statistical analysis of errors. **Sensors and Transducers:** Types of sensors, types of transducers and their characteristics. **Signal transmission and processing:** Devices and systems, Signal Display & Recording Devices.

Unit II

Time related measurements: Counters, stroboscope, frequency measurement by direct comparison, Measurement of displacement. **Measurement of pressure:** Gravitational, directing acting, elastic and indirect type pressure transducers, Measurement of very low pressures. **Strain measurement:** Types of strain gauges and their working, strain gauge circuits, temperature compensation. Strain rosettes, calibration. **Measurements of force and torque:** Different types of load cells, elastic transducers, pneumatic & hydraulic systems. **Temperature measurement:** By thermometers, bimetallic, thermocouples, thermistors and pyrometers. **Vibration:** Seismic instruments, vibration pickups and decibel meters, vibrometers accelerometers.

Unit III

Metrology and Inspection: Standards of linear measurement, line and end standards. Limit, fits and tolerances. Interchangeability and standardization. Linear and angular measurements devices

and systems. **Comparators:** Sigma, Johansson's Microkrator. Limit gauges classification, Taylor's Principle of Gauge Design.

Unit IV

Measurement of geometric forms like straightness, flatness, roundness, Tool makers microscope, profile project autocollimator, **Interferometry:** principle and use of interferometry, optical flat. Measurement of screw threads and gears, **Surface texture:** quantitative evaluation of surface roughness and its measurement.

Unit V

Introduction: Concept of Automatic Controls–open loop & closed loop systems. Servomechanisms. Block diagrams, transfer functions. Applications of Laplace- Transform in control systems with simple examples / numerical. **Representation of control components & Systems:** Translation & rotational mechanical components, series & parallel combinations, cascade system, analogous system. **Controllers:** Brief introduction to Pneumatic, hydraulic and electric controllers.

Textbooks:

1. Engineering Metrology by R K Jain, Khanna Publishers.
2. Engineering Measurement by R K Jain, Khanna Publishers
3. Engineering Metrology by I C Gupta, Dhanpat Rai & Sons, New Delhi, 1994.

References Books:

1. Beckwith Thomas G., Mechanical Measurements, Narosa Publishing House, N. Delhi.
2. Doeblein E.O., "Measurement Systems, Application Design", McGraw Hill, 1990.
3. Kumar D.S., "Mechanical Measurements and Control", Metropolitan, N. Delhi.
4. Hume K.J., "Engineering Metrology", MacDonald and Co. 1963.
5. Sirohi, "Mechanical Measurement" New Age Publishers.

Measurement and Metrology Lab (BME-451)

Course Outcomes (COs):

After completing this course a student will be able to:

1. Understand the concept of vernier caliper and use it for measurement of gear tooth and learn to measure taper of a shaft.
2. Understand the concept of limit gauge and slip gauge and learn the use of micrometer.
3. Perform the test of roundness, concentricity and understand the concept and use of dial gauge.
4. Understand the concept of autocollimator and to perform test of thermocouple and stroboscope.

Any 7 experiments out of followings:

1. To measure the taper of a given shaft.
2. To measure the dimensions of a gear tooth using vernier calipers.
3. Study of slip gauges.
4. Study of limit gauges.
5. To measure out of roundness of a shaft.
6. To perform the concentricity test on a spur gear.
7. To calibrate a dial gage.
8. To study and use of autocollimator.
9. To determine the speed of pedestal fan using stroboscope.
10. To calibrate and measure temperature using Thermocouple.

Engineering Fluid Mechanics (BME-402)

L T P C

3 1 2 5

Prerequisite: Basic knowledge of engineering physics.

Course Outcomes (COs):

After completing this course a student will be able to:

1. Understand property of fluid, measurement of pressure and broad principles of fluid statics.
2. Inculcate knowledge on description of fluid motion, stream and velocity potential, their properties and applications.
3. Understand the dynamics of fluid flow -energy equation and its applications and gain knowledge about dimensional and model analysis
4. Analyse the Flow through Pipes, Laminar and turbulent flows, major and minor losses in pipes.
5. Understand and solve the boundary layer problems and evaluate friction over surface.

Course Content:

Unit I

Introduction: Scope and importance of Fluid Mechanics, Physical properties of fluids ,viscosity Newton's law of viscosity, Newtonion and non-Newtonion fluids, Compressibility, Surface tension and Capillarity, vapours pressure), Rheological classification of fluids, Ideal fluid, Real Fluid.

Fluid Statics: Pressure, Pascal's Law, Hydrostatic Law, Pressure measurement devices – Piezometer, manometers, Mechanical gauges, Forces on plane and curved surfaces, Centre of pressure and pressure diagram, Buoyancy, Metacentre, Stability of Submerged and floating bodies, Fluid masses subjected to accelerations.

Unit II

Fluid Kinematics: Concept of control volume, Velocity and acceleration of fluid Particle, Lagrangian and Eulerian approach, Classification of fluid flow, Streamlines, Path lines and Streak lines, Equipotential lines, Stream Function and Velocity Potential, Flow Net, Continuity equation, Rotation, Vorticity and Circulation, Free and Forced vortex motion.

Unit III

Fluid Dynamics: Flow characteristics, the Reynolds Transport Theorem, application of continuity equation, energy equation and momentum equation. Forces acting on fluid in motion, Euler's equation, Bernoulli's Theorem and applications – Pitot Tube, Venturimeter, Orificemeter, Orifices and Mouthpieces.

Dimensional Analysis: Units and Dimensions, Dimensional analysis, Rayleigh's method, Buckingham's Π theorem, Non-dimensional numbers & their significance. Hydraulic Similitude

and Model Studies: Model and prototype; Similitude; Geometric, Kinematic and Dynamic similarity; Model Laws; Un-distorted model studies.

Unit IV

Viscous Flow: Laminar flow: Reynold's Experiment, Navier's Stokes' Equation, Coutte& Hagen Poisulle's Equation for viscous flow between parallel plates and circular pipes, Power absorbed in in viscous flow, Stokes law; Darcy's Law; Transition from laminar to turbulent flow. Introduction to Turbulant flow: Velocity distribution and Shear stresses in turbulent flow, Prandtl mixing length theory, Introduction to Moody's Chart.

Losses in pipes: Darcy - Wiesbach Equation, factors affecting friction, Minor Losses in pipes, Concept of HGL & TEL. Concept of equivalent length of pipe for different pipe fittings, Equivalent diameter of pipes, Hydraulic Power, transmission by pipe, Pipes in parallel, Series, Syphon, two reservoir problems, Water hammer in pipes, Surge tanks - function, location and uses, Pipe network.

Unit V

Laminar Boundary layer theory: Concept, Boundary layer along thin plate- Characteristics, Laminar, Turbulent Boundary Layer, laminar sub layer, Various Thicknesses- Nominal, displacement, Momentum, Energy, Hydraulically smooth and Rough boundaries, Separation of Boundary layer, control of Separation.

Forces on submerged bodies: Introduction to Drag and Lift on submerged bodies (like Flat plates, Sphere, Cylinder, aerofoil), stokes law, Drag and Lift coefficients. Introduction to Computational Fluid Dynamics (CFD)

Text Book:

1. Intro To Fluid Mechanics & Fluid Machines, Som and Biswas, Tata McGraw Hill Pvt Ltd.
2. Fluid Mechanics and hydraulics machines, Sukumar pati, Tata McGraw Hill Pvt Ltd.
3. A Textbook of Fluid Mechanics and Hydraulic Machines, R.K. Bansal, Laxmi Publications

Reference Book:

1. Fluid Mechanics, White, Tata McGraw Hill.
2. Fluid Mechanics, Cengel & Cimbala, Tata McGraw-Hill.
3. Introduction to Fluid Mechanics, Fox and Pritchard, Seventh Edition. Wiley India.
4. Fluid Mechanics and Hydraulic Machines: Problems and Solutions, K. Subramanya, McGraw Hill Education

Engineering Fluid Mechanics Lab (BME-452)

Course Outcomes (COs):

After completing this course a student will be able to:

1. Verify the Bernoulli's Theorem.

2. Determine the friction factor for the pipes.
3. Determine the coefficient of discharge of Venturimeter and Orifice meter.
4. Determine the minor losses due to sudden enlargement, sudden contraction and bends.
5. Determine the coefficient of discharge of Notch (V and Rectangular types).

List of Experiments: (At least 8 of the following)

1. To determine the meta-centric height of a floating body.
2. To verify the Bernoulli's Theorem.
3. To determine coefficient of discharge of an orifice meter.
4. To determine the coefficient of discharge of venturi meter.
5. To determine the friction factor for the pipes.
6. To determine the coefficient of discharge, contraction & velocity of an orifice.
7. To determine the minor losses due to sudden enlargement, sudden contraction and bends.
8. To find critical Reynolds number for a pipe flow.
9. To determine the coefficient of impact for vanes.
10. To determine the coefficient of discharge of Notch (V and Rectangular types).
11. To show the velocity and pressure variation with radius in a forced vertex flow.

Manufacturing Science I (BME-403)

L T P C

3 0 2 4

Prerequisite: Course on Workshop Technology

Course Outcomes (COs):

After completing this course a student will be able to:

1. Define the term manufacturing and its importance towards technological and social economic development.
2. Classify the basic principles of casting processes and discuss its type's defects and remedies.
3. Design of gating/riser system needed for casting
4. Describe the various forming process like (rolling, forging, extrusion, drawing, sheet metal operation) and Implement a suitable forming process for a given component.
5. Compare the various types of joining processes and select the appropriate one according to the application.
6. Discuss the recent emerging areas in primary manufacturing process like powder metallurgy.

Course Content:

Unit I

Introduction: Importance of manufacturing towards technological and social economic development. Classification of manufacturing processes.

Casting: Basic principle of casting processes. Types of patterns and allowances. Types and properties of molding sand. Introduction and Design of Gating system. Risering design. Solidification of casting. Types of casting- Die Casting, Centrifugal casting. Investment casting, CO_2 casting, casting defects & remedies, Cupola furnace.

Unit II

Metal Forming Processes: Nature of plastic deformation-Hot working and cold working.

Rolling: Principle, types of rolling mills, rolling load calculation, rolling defects.

Forging: Types of forging operations-smith, drop, press and machine forging. Forging load estimation. Forging defects.

Extrusion: Principle, Hot extrusion, Cold extrusion processes. Extrusion defects. Tube drawing and wire drawing: Introduction and defects.

Unit III

Sheet Metal working: Introduction to shearing operations, Blanking, piercing, Drawing, Spinning, Bending, Embossing and coining processes Presses and their classification, die and punch assembly, sheet metal die- progressive, compound and combination dies.

Unit IV

Welding: Principle of welding, classification of welding, HAZ, Arc welding concept, Arc blow, **Arc welding operation:** Tungsten inert gas welding, gas metal arc welding, submerged arc welding. Resistance welding and its types, Gas welding- oxy acetylene welding, Soldering and Brazing. Residual stresses in welding and its remedies, welding defects.

Unit V

Powder Metallurgy:

Introduction, production of metallic powder, processing methods-mixing and blending, compacting, sintering, secondary operations, Advantages of powder metallurgy.

Text books:

1. Manufacturing Technology by P.N. Rao., TMH.
2. Manufacturing Science by Ghosh and Mallik.
3. Production Engg. Science by P.C. Pandey.

Reference books:

1. Production Technology by R.K. Jain.
2. Materials and Manufacturing by Paul Degarmo.
3. Manufacturing Engineering & Technology by Kalpakjian, Pearson Pub.

Manufacturing Science I Lab (BME-453)

Course Outcomes (COs):

After completing this course a student will be able to:

1. Design the gating and riser system needed for casting and requirements to achieve defect free casting.
2. Understand the basic geometry of pattern making and their application.
3. To gain the knowledge of Forging technique and application in industrial domain.
4. Design the jigs and fixtures required for various mechanical works.
5. Understand the working of press working operation like blanking and piercing.

Any 8 experiments out of following:

1. Design of pattern for a desired casting (containing hole).
2. Pattern making.
3. Making a mould (with core) and casting.
4. Injection moulding with plastics.
5. Hand forging processes
6. Forging - power hammer study & operation.
7. Tube bending with the use of sand and on tube bending m/c.
8. Press work experiment such as blanking/piercing, washer, making etc.
9. Bending & spring back.
10. Jigs & Fixture experiment.

Theory of Machines I (BME-404)

L T P C

3 1 0 4

Prerequisite: A course on Engineering Thermodynamics and Engineering Drawing.

Course Outcomes (COs):

After completing this course a student will be able to:

1. Define various components of mechanisms, Develop mechanisms to provide specific motion.
2. Draw velocity and acceleration diagrams of various mechanisms.
3. Basic ideas of kinematic synthesis
4. Understand the importance of Cams, Gain the basic ideas of kinematics of Cams,
5. Understand the basic ideas of gears and also Analyze speed and number of teeth in various gears, Select appropriate power transmission for specific application.

Course Content:

UNIT I

Introduction: Links-types, Kinematics pairs-classification, Constraints-types, Degree of Freedom, Grubler's equation, linkage mechanisms, inversions of four bar linkage, slider crank chain and double slider crank chain.

Velocity in Mechanisms: Velocity of point in mechanism, relative velocity method, instantaneous point in mechanism, Kennedy's theorem, instantaneous center method.

UNIT II

Acceleration in Mechanisms: Acceleration diagram, Coriolis component of acceleration, Klein's construction for Slider Crank and Four Bar mechanism, Analytic method for slider crank mechanism.

Mechanisms with Lower Pairs: Pantograph, Exact straight line motion mechanisms - Peaucellier's, Hart and Scott-Russell mechanisms, Approximate straight line motion mechanisms – Grass-Hopper, Watt and Tchebicheff mechanisms, Analysis of Hook's joint, Davis and Ackermann Steering gears.

UNIT III

Kinematics Synthesis of Planar Linkages: Movability of four bar linkages, Grashoff's law, Graphical methods of synthesis – Two and Three position synthesis of four bar and slider crank mechanisms, Analytical method-Freudenstein's equation for function generation (three position).

UNIT IV

CAMS: Cams and Followers - Classification & terminology, Cam profile by graphical methods for uniform velocity, simple harmonic motion and parabolic motion of followers, Analytical cam design – tangent and circular cams.

UNIT V

Gears: Classification & terminology, law of gearing, tooth forms, interference, under cutting, minimum number of teeth on gear and pinion to avoid interference, simple, compound and planetary gear trains.

Textbooks:

1. Theory of Machines by S. S. Rattan
2. Theory of Machines by J E Shingley
3. Theory of Machines by R. K. Bansal.
4. Theory of Machines by V. P. Singh.
5. Theory of Machines by Khurmi & Gupta.

References Books:

1. Theory of machines by Thomas Bevan.
2. Theory of machines and mechanisms by Ghosh & Mallik
3. Theory of machines and mechanisms by Rao &Dukkipati.
4. Theory of Machines by Malhotra & Gupta.
5. Mechanics of Machines by V. Ramamurti.
6. Kinematics by HN Tyson.

Applied Thermodynamics (BME-405)

L T P C

3 1 2 5

Prerequisite: A course on Engineering Thermodynamics and Engineering Drawing.

Course Outcomes (COs):

After completing this course a student will be able to:

1. Analyze the cycle of internal combustion engine in order to perform heat, work and efficiency calculation.
2. Understand the vapour cycle in order to carry out the calculation on system performance.
3. Understand boilers and their performance, understand condenser and their performance.
4. Construct steam engine velocity diagram in order to determine the stage calculation mathematically and graphically.
5. Analyze the various gas turbine plant system arrangement in order to perform heat, work, efficiency calculation.

Course Content:

Unit I

Introduction to solid, liquid and gaseous fuels– Stoichiometry, exhaust gas analysis- First law analysis of combustion reactions- Heat calculations using enthalpy tables- Adiabatic flame temperature Chemical equilibrium and equilibrium composition calculations use free energy. Introduction and Otto, Diesel and Dual cycles.

Unit II

Vapour Power cycles: Vapor power cycles Rankine cycle with superheat, reheat and regeneration, exergy analysis. Rankine cycle, effect of pressure and temperature on Rankine cycle, Reheat cycle, Regenerative cycle, Feed water heaters, Binary vapour cycle, Combined cycles, Cogeneration.

Fuels and Combustion: Combustion analysis, heating values, air requirement, Air/Fuel ratio, standard heat of reaction and effect of temperature on standard heat of reaction, heat of formation, Adiabatic flame temperature.

Unit III

Boilers: Classifications and working of boilers, boiler mountings and accessories, Draught and its calculations, air pre-heater, feed water heater, super heater. Boiler efficiency, Equivalent evaporation. Boiler trial and heat balance.

Condenser: Classification of condenser, air leakage, condenser performance parameters.

Unit IV

Steam and Gas Nozzles: Flow through Convergent and convergent-divergent nozzles, variation of velocity, area and specific volume, choked flow, throat area, Nozzle efficiency, Off design

operation of nozzle, Shock waves stationary normal shock waves, Effect of friction on nozzle, Super saturated flow.

Steam Turbines: Classification of steam turbine, Impulse and Reaction turbines, Staging, Stage and Overall efficiency, reheat factor, Bleeding, Velocity diagram of simple and compound multistage impulse and reaction turbines and related calculations, work done, efficiencies of reaction, Impulse reaction turbines, state point locus, Losses in steam turbines, Governing of turbines, Comparison with steam engine.

Unit V

Gas Turbine: Gas turbine classification, Brayton cycle, Principles of gas turbine, Gas turbine cycles with intercooling, reheat and regeneration and their combinations, Stage efficiency, Polytropic efficiency. Deviation of actual cycles from ideal cycles.

Jet Propulsion: Introduction to the principles of jet propulsion, Turbojet and turboprop engines and their processes, Principle of rocket propulsion, Introduction to Rocket Engine.

Reciprocating compressors, staging of reciprocating compressors, optimal stage pressure ratio, effect of intercooling, minimum work for multistage reciprocating compressors.

Text Books:

1. Basic and Applied Thermodynamics by P.K. Nag, Mcgraw hill india.
2. Engineering Thermodynamics, by P.K. Nag, Mcgraw hill india.
3. Applied thermodynamics by Onkar Singh, New Age International.

Reference Books:

1. A Course in Thermal Engineering, Domkundwar and KothandaramanDhanpat Rai & Co. (P) Limited.
2. Applied Thermodynamics by Venkanna And Swati, PHI.
3. Thermodynamics: An Engineering Approach, Yunus A Cengel; Michael A Boles, McGraw-Hill Education.

Applied Thermodynamics (BME-455)

Course Outcomes (COs):

After completing this course a student will be able to:

1. Understand the working principles & knowledge of parts of boilers.
2. Understand the working principles & pats of two stroke I C Engines.
3. Understand the working principles & parts of four stroke I C Engines.
4. Demonstrate the performance of internal combustion engine.
5. Understand the working Principles & parts of steam & gas turbine.

List of Experiments: (At least 8 of the following)

1. Study of Fire Tube boiler.

2. Study of Water Tube boiler.
3. Study and working of Two stroke petrol Engine.
4. Study and working of Four stroke petrol Engine.
5. Determination of Indicated H.P. of I.C. Engine by Morse Test.
6. Prepare the heat balance sheet for Diesel Engine test rig.
7. Prepare the heat balance sheet for Petrol Engine test rig.
8. Study and working of two stroke Diesel Engine.
9. Study and working of four stroke Diesel Engine.
10. Study of Velocity compounded steam turbine.
11. Study of Pressure compounded steam turbine.
12. Study of Impulse & Reaction turbine.
13. Study of steam Engine model.
14. Study of Gas Turbine Model.

Human Value and Professional Ethics (MC402/MC-302)

L T P C

2 0 0 0

Prerequisite:

Course Outcomes (COs):

After completing this course a student will be able to:

1. Understand the significance of value inputs in a classroom, distinguish between values and skills, understand the need, basic guidelines, content and process of value education, explore the meaning of happiness and prosperity and do a correct appraisal of the current scenario in the society
2. Distinguish between the Self and the Body, understand the meaning of Harmony in the Self the Co-existence of Self and Body.
3. Understand the value of harmonious relationship based on trust, respect and other naturally acceptable feelings in human-human relationships and explore their role in ensuring a harmonious society
4. Distinguish between ethical and unethical practices, and start working over the strategy to actualize a harmonious environment wherever they work.

Course Content:

UNIT I

Course Introduction: Need, Basic Guidelines, Content and Process for Value Education Understanding the need, basic guidelines, content and process for Value Education, Self-Exploration–what is it? - its content and process; 'Natural Acceptance' and Experiential Validation- as the mechanism for self-exploration, Continuous Happiness and Prosperity- A look at basic Human Aspirations, Right understanding, Relationship and Physical Facilities- the basic requirements for fulfilment of aspirations of every human being with their correct priority, Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario, Method to fulfill the above human aspirations.

UNIT II

Understanding Harmony in the Human Being : Harmony in Myself Understanding human being as a co-existence of the sentient 'I' and the material 'Body', Understanding the needs of Self ('I') and 'Body' - Sukh and Suvidha, Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer), Understanding the characteristics and activities of 'I' and harmony in 'I', Understanding the harmony of I with the Body: Sanyam and Swasthya; correct appraisal of Physical needs, meaning of Prosperity in detail, Programs to ensure Sanyam and Swasthya.

UNIT III

Understanding Harmony in the Family and Society: Harmony in Human-Human Relationship Understanding harmony in the Family- the basic unit of human interaction, Understanding values in

human-human relationship; meaning of Nyaya and program for its fulfillment to ensure Ubhay-tripti (Mutual Happiness); Trust (Vishwas) and Respect (Samman) as the foundational values of relationship, Understanding the meaning of Vishwas; Difference between intention and competence, Understanding the meaning of Samman, Difference between respect and disrespect; the other salient values in relationship, Understanding the harmony in the society (society being an extension of family): Samadhan, Samridhi, Abhay, Sah-astitva as comprehensive Human Goals, Visualizing a universal harmonious order in society.

UNIT IV

Understanding Harmony in the Nature and Existence: Whole existence as Co-existence Understanding the harmony in the Nature, Interconnectivity and mutual fulfillment among the four orders of nature- recyclability and self-regulation in nature, Understanding Existence as Co-existence (Sah-astitva) of mutually interacting units in all-pervasive space, Holistic perception of harmony at all levels of existence.

UNIT V

Implications of the Holistic Understanding of Harmony on Professional Ethics Natural acceptance of human values, Definitiveness of Ethical Human Conduct, Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order, Competence in Professional Ethics: a) Ability to utilize the professional competence for augmenting universal human order, b) Ability to identify the scope and characteristics of people-friendly and ecofriendly production systems, technologies and management models. Improving quality of work life at work place.

Text Books:

1. A Nagraj, 1998, Jeevan Vidya EkParichay, Divya Path Sansthan, Amarkantak.
2. R. Subramanian,2017, Professional Ethics,
3. P L Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Publishers.
4. 4. A N Tripathy, 2003, Human Values, New Age International Publishers.

Reference Books:

1. Subhas Palekar, 2000, How to practice Natural Farming, Pracheen (Vaidik) Krishi Tantra Shodh, Amravati.
2. E G Seebauer & Robert L. Berry, 2000, Fundamentals of Ethics for Scientists &Engineers , Oxford University Press.
3. M Govindrajran, S Natrajan & V.S. Senthil Kumar, Engineering Ethics (including Human Values), Eastern Economy Edition, Prentice Hall of India Ltd.
4. B P Banerjee, 2005, Foundations of Ethics and Management, Excel Books.
5. B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted.

Internal Combustion Engines (BME-501)

L T P C

3 1 2 5

Prerequisite:

Course Outcomes (COs):

1. Understand various types of I.C. engines and cycles of operation.
2. Understand the normal and abnormal combustion phenomenon in SI and CI engines.
3. Identify fuel metering and fuel supply systems for different types of engines
4. Interpret different alternative fuels and its emissions, then the method to control these emissions and their effect on environment.
5. Understand supercharging and its effect on performance of SI and CI engine.

Course Content:

Unit I

Introduction to I.C Engines: Engine classification, Application, Constructions details, Working principle, Air standard cycles, Otto, Diesel, Stirling, Ericsson cycles, Actual cycle analysis, Two and four stroke engines, SI and CI engines, Valve timing diagram, Rotary engines, Environment friendly engines.

Unit II

SI Engines: Carburetion, Mixture requirements, Carburetor types, Theory of carburetor, MPFI. Combustion in SI engine, Flame speed, Ignition delay, abnormal combustion and it's control, combustion chamber design for SI engines. Ignition system requirements, Magneto and battery ignition systems, ignition timing and spark plug, Electronic ignition.

Unit III

CI Engine: Fuel injection in CI engines, Requirements, Types of injection systems, Fuel pumps, Fuel injectors, Injection timings. Combustion in CI engines, Ignition delay, Knock and it's control, Combustion chamber design of CI engines. Scavenging in 2 Stroke engines, pollution and it's control.

Unit IV

Engine Cooling and Lubrication: Different cooling systems, Radiators and cooling fans. Engine friction, Lubrication principal, Type of lubrication, Lubrication oils, Crankcase ventilation.

Fuels: Fuels for SI and CI engine , important qualities of SI engine fuels, Rating of SI engine fuels, Important qualities of CI engine fuels, Dopes, Additives, Gaseous fuels, LPG, CNG, Biogas, Producer gas, Alternative fuels for IC engines.

Unit V

Supercharging: Effect of altitude on power output, Types of supercharging.

Testing and Performance: Performance parameters, Basic measurements, Blow by measurement, Testing of SI and CI engines.

Air Pollution and Control: Sources and classification, Effects of air pollution, Pollutants from I. C. engines, Mechanism of formation of pollutants, Particulate emissions, Exhaust gas treatmen

Text Books:

1. A Course in International Combustion Engines, by Mathur & Sharma, Dhanpat Rai & Sons.
2. I.C Engine, by Ganeshan, Tata McGraw Hill Publishers.
3. I.C Engine, by R. Yadav, Central Publishing House, Allahabad.

Reference Books:

1. Fundamentals of Internal Combustion Engine by Gill, Smith, Ziurs, Oxford & IBH Publishing COIC.
2. Engines, by Rogowsky, international Book Co.
3. Reciprocating and Rotary Compressors, by Chlumsky, SNTI Publications Czechoslovakia.
4. I.C Engine Analysis & Practice by E.F Obert.

Internal Combustion Engines Lab (BME-551)

Course outcome (COs):

1. Identify the various types of I.C. Engines and cycles of operation.
2. Express the effect of various operating variables on engine performance.
3. Demonstration of fuel metering and fuel supply systems for different types of engines.

List of Experiments:

Any 8 experiments out of following:

1. To study the cut models of I.C. Engines.
2. To study the actual valve timing diagram of 4-stroke petrol engine.
3. To study the actual valve timing diagram of 4-stroke diesel engine.
4. To determine the Morse test on a multi cylinder petrol engine.
5. To study the performance of single cylinder, 4 stroke, diesel engine connected to eddy current dynamometer in manual/computerized mode.
6. To study the performance of 3-cylinder, 4 stroke, petrol engine connected to dynamometer in manual mode.
7. To draw pressure-crank angle plot, pressure volume plot and calculate indicated power of the diesel engine.
8. Determination of volumetric efficiency and draw indicator (P-V) diagram of reciprocating compressor.
9. Dismantling and assembling of carburettor and its study.
10. Study of different types of fuel injection systems.
11. To study and determine the effect of A/F ratio on the performance of a Petrol engine.
12. Study of Fire Tube and Water Tube boiler models.

Theory of Machines II (BME-502)

L T P C

3 1 2 5

Prerequisite: A course on Engineering Mechanics and Thermodynamics.

Course Outcomes (COs):

After completing this course a student will be able to:

1. Understand of force analysis of linkages and Demonstrate functioning of single slider crank mechanism and its inversions based systems.
2. To analyze the different types of governors and flywheels.
3. Understand the concept of gyroscopic couple for ships, aero planes and road vehicles.
4. To balancing of the reciprocation and rotatory systems.
5. Demonstrate functioning clutches and brakes.

Course Contents:

UNIT I

Force Analysis, Turning Moment & Fly wheel: Static force analysis of linkages, Equivalent offset inertia force, Dynamic analysis of slider crank & Bar mechanism. Piston and Crank effort, Inertia, Torque, Turning moment diagrams, Fluctuation of energy, Flywheel.

UNIT II

Governors: Introduction, types of governors, characteristics of centrifugal governors, gravity controlled and spring controlled centrifugal governors, hunting of centrifugal governors, Sensitivity, Stability, Hunting, Isochronism, inertia governors. Effort and Power of governor, Controlling force diagrams for Porter governor and spring controlled governors.

UNIT III

Gyroscopic Motion: Space motion of rigid bodies, angular momentum, gyroscopic couples, gyroscopic stabilization, ship stabilization, stability of four wheel and two wheel vehicles moving on curved paths.

UNIT IV

Balancing of machines: Static and dynamic balancing, Primary and secondary forces and couples. Balancing of rotating and reciprocating masses, methods of balancing the primary and secondary unbalanced forces, partial balancing, field balancing.

UNIT V

Friction: Pivot and collar friction, Friction circle, Single plate, Multi plate and Cone clutches.

Brakes and Dynamometers (Mechanical Type): External and internal shoe brakes, Band and Block brakes, Hydraulic brakes, Absorption and Transmission dynamometers.

Text Books:

1. Theory of Machine: S.S.Ratan (TMH).
2. Theory of Machine- R.K.Bansal (Laxmi publication)
3. Theory of Machines by R S Khurmi.

References Books:

1. Mechanisms & Dynamics of Machines-Mabie.
2. Theory of Machine & Mechanism-Shiglay.
3. Mechanisms and Machine Theory-A.K. Ambedkar (Jain Bros).
4. Theory of Machines- W.T.Green.
5. Mechanisms and Machine Theory- Rao & Dukhipati (New Age).
6. Theory of Machine & Mechanism- Ghosh & Mallik.
7. Theory of Machine S-P.L. Ballaney (Khanna pub.)

Theory of Machines II Lab (BME-552)

Course Outcomes (COs):

After completing this course a student will be able to:

1. Understand the profiles of cams and its effect on follower intermittent motion.
2. Understand the concept of gyroscopic couple for ships, aero planes and road vehicles.
3. To analyze the different types of governors.
4. Examine the balancing of rotating masses in dynamic balancing.
5. Demonstrate functioning of gears.

Min. 10 out of following (or such) experiments to be done:

1. Study of simple linkers/models/mechanisms.
2. Study of inversions of four bar linkage.
3. Study of inversions of single slider crank mechanisms.
4. Study of inversions of double slider crank mechanisms.
5. Study of peculiar mechanism.
6. Study of Hart Mechanism.
7. Study of Grass-Hopper Mechanism.
8. Study of Watt Mechanism.
9. Study of Tchebicheff Mechanism.
10. Experiment on cam.
11. Experiment on Gears (tooth profile, interference etc.).
12. Experiment on Gear trains.
13. To determine the Moment of Inertia of a plane disc by using a gyroscope.
14. To determine the forces on a spring in a Hartnell Governor to determine the spring stiffness.
15. To determine the speed ratio of a spur gear.

Departmental Elective I

Manufacturing Science II (DE-ME-501)

L T P C

3 1 0 4

Prerequisite: Course on Workshop Technology.

Course Outcomes (COs):

1. Detailed knowledge of cutting tool & their geometry, nomenclature, tool materials, their properties.
2. Identify the different machines on the basis of their operations- Lathe, shaper, slotter, planer, milling, drilling and boring.
3. Understand the use of Grinding machines.
4. Understanding the concept of limits, fits, tolerances and surface finish and their utility in the industrial context
5. Identify different non-conventional machining processes and the applications of non-conventional welding.

Course Contents:

Unit I

Metal Cutting- Mechanics of metal cutting. Geometry of tool and nomenclature, ASA system Orthogonal vs. oblique cutting. Mechanics of chip formation, types of chips. Shear angle relationship. Merchant's force circle diagram. Cutting forces, power required. Cutting fluids/lubricants. Tool materials. Tool wear and tool life. Machinability. Brief introduction to machine tool vibration and surface finish. Economics of metal cutting.

Unit II

Machine Tool-Lathe: Principle, types, operations, Turret/capstan, semi/Automatic, Tool layout. **Shaper, slotter, planer:** operations & drives. **Milling:** Milling cutters, up & down milling. Dividing head & indexing. Max chip thickness & power required. **Drilling and boring:** Drilling, boring, reaming tools. Geometry of twist drills.

Unit III

Grinding: Grinding wheels, abrasive, cutting action. Grinding wheel specification. Grinding wheel wear - attritions wear, fracture wear. Dressing and Truing. Max chip thickness and Guest criteria. Surface and Cylindrical grinding. Centerless grinding.

Unit IV

Super finishing: Honing, lapping, and polishing.

Limits, Fits & Tolerance and Surface-roughness: Introduction to Limits, Fits, Tolerances and IS standards, and surface-roughness.

Unit V

Introduction to non-conventional Machining and Welding: Benefits, application and working principle of EDM, ECM, LBM, EBM, USM. AJM, WJM. Similarly, non-conventional welding application such as LBW, USW, EBW, Plasma arc welding, Explosive welding.

Textbooks:

1. Manufacturing science by Ghosh and Mallik.
2. Production Technology by R.K. Jain.
3. Advanced Machining Process - VK Jain

Reference books:

1. Fundamentals of Metal Cutting and Machine tools by Boothroyd.
2. Production Technology - H.M.T.
3. Production Engineering Science by P.C. Pandey.
4. Modern Machining Processes by P.C. Pandey & H.S. Shan.
5. Manufacturing science by Degarmo.
6. Fundamentals of metal cutting & machine tools - Juneja & Shekhon.
7. Process & materials of manufacturing - Lind burg.

Rapid Prototyping and Rapid Tools (DE-ME-502)

L T P C

3 1 0 4

Prerequisite: Course on Computer aided Design and Manufacturing and Basic course on manufacturing, numerical control and robotics

Course Outcomes (COs):

After completing this course a student will be able to:

1. Understand basics of rapid prototyping and modeling and steps of preparing prototypes.
2. Understand liquid, solid and powder based prototyping systems.
3. Understand practical applications of rapid prototyping and tooling in modern industries.
4. Become familiar with recent advances in rapid prototyping and tooling.
5. Apply the Process of Rapid Prototyping in Advanced techniques.

Course Contents:

Unit I

Introduction and fundamental to rapid Prototyping, Technology involved in Rapid Prototyping, Classifications of rapid Prototyping system. Rapid Prototyping Process chain, 3-D Modeling Data conversion and Trans mission Checking and Preparing, Building, Post Processing.

Rapid Prototyping Data formats: STL Format and its Problem, STL File Repair, Newly Proposed Formats

Unit II

Liquid Based Rapid prototyping Systems: Streolithography Apparatus (SLA), Solid Ground Curing (SGC), Solid Creation System (SCS), Rapid Freeze Prototyping, Microfabrication.

Unit III

Solid Based Rapid prototyping systems: Laminated Object Manufacturing (LOM), Fused Deposition modeling (FDM), Paper Lamination Technology (PLT),

Powder based rapid Prototyping Systems: Selective Laser Sintering Z-Corporation 3-D Printing (3DP), EOSINT Systems.

Unit IV

Applications and Advantages of Rapid prototyping: Manufacturing and Tooling. Aerospace Industry. Automotive Industry, Biomedical Industry, Design, Jewelry of Rapid Prototyping,

Unit V

Advance Topics in Rapid Prototyping: Optimum part deposition orientation and algorithms, Adaptive slicing and algorithms.

Text Books:

1. Rapid Prototyping: Principles and Applications by Chua C.K.,Leong K.F. and Lim C.S. World Scientific publications.
2. Rapid Prototyping : Principles and Applications by RafiqNoorani John Wiley

Reference books:

1. Laser-Induced Materials And Processes For Rapid Prototyping by Lu,L.,Fuh,J.Y. H.& Wong,Y.S.
2. Rapid Prototyping Laser-Based And Other Technologies by Venuvinod, PatriK & Ma, Weiyin.

Tribology (DE-ME-503)

L T P C

3 1 0 4

Prerequisite: Basic of Engineering mechanics and Design of machine elements.

Course Outcomes (COs):

After completing this course a student will be able to:

1. Understand and explain different laws of friction and topology of surfaces.
2. Appreciate the various modes of wear and the wear mechanism maps.
3. Understand behavior of bearing in different lubrication regimes and able to develop mathematical model.
4. Differentiate between the types of lubricants and its respective application area.
5. Select the type of bearing for any given required engineering use and determine the load carrying capacity and other related parameters.

Course Contents:

Unit I

Introduction to Tribology: Definition, Scope, Applications, Friction, Definition, Scope, Laws of friction. Friction theories. Surface contaminants, Effect of sliding speed on friction.

Unit II

Wear: Definition, Scope, wear of metals, Types, Classification. Mechanism of wear, Quantitative laws. Hypothesis of Holm. Hypothesis of Burwell and Strang. Hypothesis of Archard, Rawe, Rabinowicz. Quantitative law for Abrasive wear, Bayerku surface fatigue theory. Delamination theory & Fatigue theory of wear, wear resistant materials. Introduction to wear of Polymers and Ceramics. Wear reduction by Surface Improvements, Pitting, Erosion & Stress Corrosion.

Unit III

Surface Interactions: Elastic & Plastic deformation of surfaces. Contact of Solids, Contact of Ideally Smooth Surfaces. Distribution of Pressure over elastic contact of two curvilinear bodies. Formulae for calculation of contact area. Physico-Mechanical properties of surface layers, Characteristics of Surface Geometry. Classes of surface roughness. Contact of rough surfaces. Interaction of surface peaks. Real and contour area of contact.

Unit IV

Lubrication: Definition & Scope. Generalized Reynolds's equation. Flow and shear stress, energy equation. Mechanism of pressure development in bearings. Concept of Boundry Layer.

Unit V

Bearing design considerations & characteristics: Bearing design procedure & steps. Plain slider bearing. Step (Rayleigh step) bearing. Infinitely long journal bearing. Infinitely short journal bearing. Future scope and applications.

Textbooks:

1. Introduction to Tribology of bearings by - B. C. Majumdar., S Chand & Co.
2. Tribology in Industries by Sushil. K. Srivastava, S Chand & Publications.

Reference Books:

1. Hand Book of Tribology – WHILEY
2. Fundamentals of Fluid film lubrication by – Bernard Hamrock, Mc Graw Hill International Edition.
3. Basic Lubrication theory by Alastair Cameron.

Open Elective I

Industrial Engineering and Automation (OE-ME-501)

L T P C

3 0 0 3

Prerequisite: Basic Knowledge of Workshop Practice.

Course Outcomes (COs):

After completing this course a student will be able to:

1. Analyze and explain productivity concepts and measurements.
2. Explain various Industrial Layout and time study.
3. Exhibit skills towards program evaluation and review technique.
4. Analyze and perform Break even analysis.
5. Understand of High Volume Production Systems, Transfer Devices and Feeder.

Course Contents:

Unit I

Introduction: Engineering economy and costing, cost analysis, methods of depreciation, productivity concepts and measurements, job evaluation, methods of job evaluation, merit rating, wage incentive plan, types of wage incentive plans.

Unit II

Work measurement, time study, predetermined motion and time study (PMTS), work sampling, method study, micro motion study, principles of motion economy.

Unit III

Plant location, Types of Layout, Principles of Facility Layout, Objective Functions, Steps in PPC, Planning, Routing, Scheduling, Loading, Dispatching, Effectiveness of PPC.

Unit IV

PERT, CPM, Resource Allocation and GERT- Program Evaluation and Review Technique (PERT), Critical Path Method (CPM), Scheduling with Resource Constraints. Introduction to quality management, Ergonomics.

Unit V

High Volume Production Systems- Transfer Devices, Feeder classification, Construction and Applications, Automated Flow lines, Analysis of Automated Flow lines for Reliability and Efficiency, Assembly Systems, Robot Technology, Flexible Manufacturing Systems (FMS).

Textbooks:

1. Industrial Engineering by M.S. Mahajan, Dhanpat Rai and Co. (P) Ltd.
2. Introduction to Robotics by S.K. Saha, Tata Magraw Hill

Reference Books:

1. Introduction to Industrial System Engineering by Turner w.c. et Al 1993,Prentice Hall
2. Motion and Time Study, Design and Measurement of Work by Ralph M. Barnes, Wiley Publishers**.**
3. Project Management for Business and Technology by John M Nicholas, PHI
4. Robotics by John M Nicholas, Pearson Education.

Total Quality Management (OE-ME-502)

L T P C

3 0 0 3

Prerequisite: Basic Knowledge of Industrial Engineering

Course Outcomes (COs):

After completing this course a student will be able to:

1. Describe the dimensional barrier regarding Quality.
2. Summarize the Total quality principles.
3. Demonstrate the tools utilization for quality improvement. Analyze the various types of techniques are used to measure quality
4. Discover the new decision of principle in real time projects.
5. Apply the various quality systems in implementation of Total quality management.

Course Contents:

Unit I

Quality Concepts: Evolution of Quality control, concept change, TQM Modern concept, Quality concept in design. Control on Purchased Product: Procurement of various products, evaluation of supplies, capacity verification, Development of sources, procurement procedure.

Manufacturing Quality: Methods and Techniques for manufacture, Inspection and control of product, Quality in sales and services, Guarantee, analysis of claims.

Unit II

Quality Management: Organization structure and design, Quality function, decentralization, Designing and fitting organization for different types products and company, Economics of quality value and contribution, Quality cost, optimizing quality cost, seduction programme.

TQM Principles: Leadership, strategic quality planning; Quality councils- employee involvement, motivation; Empowerment; Team and Teamwork; Quality circles, recognition and reward, performance appraisal; Continuous process improvement; PDCE cycle, 5S, Kaizen; Supplier partnership, Partnering, Supplier rating & selection.

Unit III

Tools and Techniques: Seven QC tools (Histogram, Check sheet, Ishikawa diagram, Pareto, Scatter diagram, Control chart, flow chart).

Control Charts: Theory of control charts, measurement range, construction and analysis of R charts, process capability study, use of control charts, P-charts and C-charts.

Unit IV

Defects Diagnosis and Prevention: Defect study, identification and analysis of defects, corrective measure, factors affecting reliability, MTTF, calculation of reliability, Building reliability in the

product, evaluation of reliability, interpretation of test results, reliability control, maintainability, zero defects, quality circle.

Unit V

IS0 and its concept of Quality Management: Quality systems, need for ISO 9000, ISO 9001-9008; Quality system- elements, documentation, Quality auditing, QS 9000, ISO 14000- concepts, requirements and benefits; TQM implementation in manufacturing and service sectors, Auditing, Taguchi method, JIT in some details.

Textbooks:

1. Total Quality Management by Mukherjee, P.N.
2. Janakiraman B. and Gopal R.K., Total Quality Management, Prentice Hall India, 2006.
3. Total Quality Management, by Dale H. Bester field, Pearson India.

Reference books:

1. Beyond Total Quality Management, Greg Bounds, McGraw Hill.
2. Bester field D.H. et al., Total quality Management, 3rd ed., Pearson Education Asia, 2006.
3. Evans J.R. and Lindsay W.M., The management and Control of Quality, 8th ed., first Indian edition, Cengage Learning, 2012.
4. Suganthi L. and Samuel A., Total Quality Management, Prentice Hall India, 2006.
5. TQM in New Product manufacturing, H. G. Menon, McGraw Hill.

Production Planning and Control (OE-ME-503)

L T P C

3 0 0 3

Prerequisite:

Course Outcomes (COs):

After completion of this course student will be able to:

1. Understand the role Production Planning and control activities in Manufacturing and Services.
2. Understand and perform various Forecasting techniques and problems.
3. Understand and perform various Inventory Management techniques and apply in real manufacturing scenario/How to use MRP/ERP.
4. Demonstrate various Scheduling procedures/Balancing concepts.
5. Understand and Evaluate Dispatching procedures.

Course Contents:

UNIT I

Introduction: Definitions – objectives of production planning and control functions of production planning and control-elements of production control types of production- organization of production planning and control – internal organizations department.

UNIT II

Forecasting: Importance of forecasting – types of forecasting, their uses general principles of forecasting techniques- Qualitative methods and quantitative methods.

UNIT III

Inventory management: Functions inventory- Relevant inventory cost- ABC analysis- VED Analysis- EOQ model – Inventory control systems – P- Systems and Q – Systems Introduction to MRP and ERP, LOB (Line of balance), JIT inventory, Japanese concepts.

UNIT IV

Routing: Definition **–** routing procedure- Route sheets – Bill of material factors affecting routing procedure. Schedule – definition – difference with loading. Scheduling polices – techniques, standard scheduling methods- job shop, flow shop, Line balancing, aggregate planning- methods for aggregate planning- Chase planning, expediting, control aspects.

UNIT V

Dispatching: Activities of dispatcher- Dispatching procedure - follow up – definition – reasons for existence of functions – types of follow up, applications of computer in production planning and control

Textbooks:

1. K C Jain and L N Agarwal, Production Planning and Control, 6th edition, Khanna Publishers, 2008.
2. M Mahajan, Production Planning and Control, Dhanpat Rai & Co., 2010.

Reference Books:

1. R Paneerselvam, Production & Operations Management, 2nd edition, PHI Publications, 2006.
2. E S Baffa and R K Sarin, Modern Production & Operation Managements, 8th edition, Wiley Publications, 2009.
3. O P Khanna, Industrial Engineering and Management, Dhanpat Rai & Co., 2009.
4. Samuel Eilon, Elements of Production Planning and Control, The Macmillan Company, New York.
5. S D Sharma, Operations Research, Kedarnath Ramnath Publishers, 1996.
6. J K Sharma, Operations Research, 4th edition, Macmillan India Limited, 2009.
7. P Ramamurthy, Production and Operations Management, New Age International Publications, 2007
8. K L Narayana, P Kannaiah and K Venkata Reddy, Machine Drawing, 3rd edition, New Age Publications, 2006.

Value Engineering (OE-ME-504)

L T P C

3 0 0 3

Prerequisite:

Course Outcomes (COs):

After completing this course a student will be able to:

1. Understand concepts of value engineering and value analysis.
2. Understand the evaluation techniques of function and problem setting and solving systems.
3. Describe various phases involved in value engineering job plan and techniques of value engineering.
4. Understand the applications of value Analysis of management practice in different organizations.
5. Demonstrate their ability to apply value analysis in various fields.

Course Contents:

UNIT I

Introduction to value analysis: Definition of Value, Value Analysis, Value Engineering, Value management, Value Analysis versus Value Engineering, Value Analysis versus Traditional cost reduction techniques, uses, applications, advantages and limitations of Value analysis. Symptoms to apply value analysis, Coaching of Champion concept.

Type of values: Reasons for unnecessary cost of product, peeling cost Onion concept, unsuspected areas responsible for higher cost, Value Analysis Zone, attractive features of value analysis. Meaning of Value, types of value & their effect in cost reduction. Value analysis procedure by simulation. Detailed case studies of simple products.

UNIT II

Functional cost and its evaluation: Meaning of Function and Functional cost, Rules for functional definition, Types of functions, primary and secondary functions using verb and noun, Function evaluation process, Methods of function evaluation. Evaluation of function by comparison, Evaluation of Interacting functions, Evaluation of function from available data, matrix technique, MISS technique, Numerical evaluation of functional relationships and case studies.

Problem setting & solving system: A problem solvable stated is half solved, Steps in problem setting system, Identification, Separation and Grouping of functions. Case studies.

Goods system contains everything the task requires. Various steps in problem solving, case studies.

UNIT III

Value engineering job plan: Meaning and Importance of Value Engineering Job plan. Phases of job plan proposed by different value engineering experts, Information phase, Analysis phase,

Creative phase, Judgments phase, Development planning phase, and case studies. Cost reduction programs, criteria for cost reduction program, Value analysis change proposal.

Value engineering techniques: Result Accelerators or New Value Engineering Techniques, Listing, Role of techniques in Value Engineering, Details with Case examples for each of the techniques.

UNIT IV

Advanced value analysis techniques: Functional analysis system technique and case studies, Value Analysis of Management Practice (VAMP), steps involved in VAMP, application of VAMP to Government, University, College, Hospitals, School Problems etc., (service type problems).

Unit V

Total value engineering: Concepts, need, methodology and benefits.

Application of value analysis: Application of Value analysis in the field of Accounting, Appearance Design, Cost reduction, Engineering, manufacturing, Management, Purchasing, Quality Control, Sales, marketing, Material Management Etc., Comparison of approach of Value analysis & other management techniques.

Textbooks:

1. Techniques of Value Analysis and Engineering – Lawrence D. Miles - McGraw Hill Book Company - 2nd Edition.
2. Value engineering for Cost Reduction and Product Improvement – M.S. Vittal – Systems Consultancy Services – Edn.1993.
3. Value Management, Value Engineering and Cost Reduction – Edward D Heller – Addison Wesley Publishing Company-1971.

Reference books:

1. Value Analysis for Better Management – Warren J Ridge – American Management Association - Edition1969.
2. Getting More at Less Cost (The Value Engineering Way) – G. Jagannathan - Tata McGraw Hill Pub. Comp Edition1995.
3. Value Engineering – Arther E Mudge - McGraw Hill Book Comp.-Edn1981.

Occupational Health and Safety (BMC-501)

L T P C

3 0 0 0

Prerequisite:

Course Outcomes (COs):

After learning the course the students should be able to:

1. Identify the diseases associated with occupation.
2. Manage safety in industries by suggesting safety measures.
3. Identify the accidental causes & apply the preventions.
4. Identify Fire Explosion & apply PPE.
5. Identify & apply Hazards & Risk identification, Assessment and control techniques.

Course Contents:

Unit I

Occupational Health: Classification of occupational health hazards, dangerous properties of chemical and their health effects, routes of entry of toxic material into human body, permissible exposure limits, Threshold limit value, lethal dose and lethal concentration, Ergonomics, constituents of ergonomics, application of ergonomics for safety & health, occupational diseases due to metals & dusts, fumes & chemical compounds.

Unit II

Safety: Concept, Philosophy & Psychology of safety: Concept of safety, Nature of concept of safety, Philosophy of safety, safety terminology, philosophy of total safety concept, safety psychology, accident causative factors, general psychological factors

Unit III

Accident Causes and prevention: Causation, Accident problem, Reasons for prevention, factors impending safety, Accident prevention

Safety Management: Concept of management, element of management, functions, management principles, safety management & its responsibilities, safety Organization

Electrical Safety: Electricity and Hazardous, Indian standards, effects of electrical parameters on human body, safety measures for electric works

Unit IV

Fire and Explosion: Fire phenomena, classification of fire and extinguishers, statutory and other standards, fire prevention & protection system, explosion phenomena, explosion control devices, fire awareness signs

Personal Protective Equipment: Need of PPE, Indian standards, factors of selection of PPE,

non respiratory equipments, respiratory equipments.

Unit V

Hazards & Risk identification, Assessment and control techniques: Hazards, Risks & detection techniques, Preliminary hazard analysis(PHA) & hazard analysis(HAZAN), failure mode effect analysis(FMEA), Hazard and operability(HAZOP) study, Hazard ranking (DOW & MOND index), Fault tree analysis, Event tree analysis(ETA), major accident hazard control, on-site and off-site emergency plans. Safety in different industries as case study.

Industrial Management (BHSM-501)

L T P C

3 0 0 3

Prerequisite:

Course Outcomes (COs):

1. Understand the basic concepts of management and explain the various principles of management
2. Understand the various functions of personal management and solves workers related problem
3. Recall the concept of marketing and examine various marketing strategies.
4. Explain the importance of financial management, relate it with break-even analysis and budget.
5. Understand the various principles of plant management & classify different type of material handling equipment's.

Course Contents:

Unit I

Introduction: Concept and scope of Industrial Management. Productivity: Definition, measurement, productivity index, types of production system, Industrial Ownership.

Unit II

Functions of Management: Taylor's Scientific Management Theory, Fayol's Principles of Management, Social responsibilities of Management, Introduction to Human resources management: Nature of HRM, functions and importance of HRM.

Unit III

Work Study: Introduction, definition, objectives, steps in work study, Method study: definition, objectives, steps of method study, Work Measurement: purpose, types of study — stop watch methods — steps — allowances — standard time calculations — work sampling, Production Planning and Control Inventory Control: Inventory, Cost, Models of inventory control: EOQ, ABC, VED

Unit IV

Quality Control: statistical quality control, Control charts for variables and attributes, Acceptance Sampling- Single sampling- Double sampling plans, Introduction to TQM.

Unit V

Project Management: Project network analysis, CPM, PERT and Project crashing and resource Leveling.

Textbooks:

1. Engineering Management (Industrial Engineering & Management)/ S.C. Sharma & T.R. Banga, Khanna Book Publishing Co. (P) Ltd., Delhi (ISBN: 978-93-86173-072)
2. Industrial Engineering and Management/ P. Khanna, Dhanpatrai publications Ltd.

Reference books:

1. Production & Operation Management /Paneer Selvam /PHI.
2. Industrial Engineering Management/NVS Raju/Cengage Learning.
3. Industrial Engineering Management I Ravi Shankar/ Galgotia.

Design of Machine Elements (BME-601)

L T P C

3 1 0 4

Prerequisite: Basic knowledge of Engineering Drawing and Machine Drawing.

Course Outcomes (COs):

After completing this course a student will be able to:

1. Understanding of Design requirements, Design procedure, Design for Static Load by using Theory of failure.
2. Be able to apply knowledge of the stress and strain for analyze and Design for Fluctuating Loads. Develop Logical and Analytical ability to apply Knowledge to Design of Riveted Joints.
3. Apply the knowledge of stress & strain in combined loading condition to design Shaft, Keys and Couplings.
4. Understand the standard geometry, application, failures of Spur and Helical Gear and Design and Developed effectively Spur and Helical Gears for different loading conditions.
5. Understand the standard geometry, applications, failures of Sliding contact bearings and Design and Developed effectively sliding contact bearings for different loading conditions as per manufacturer catalog.

Course Contents:

Unit I

Introduction: Definition, Design requirement of machine elements, Design procedure, standards in design & selection of preferred size. Selection of materials for static & fatigue loads, Indian Standard designation of carbon and alloy steels.

Design for Static Load: Modes of failure, Factor of safety, Revision of concepts of Stresses due to bending, torsion and Theory of failure.

Unit II

Design for Fluctuating Loads: Cyclic stresses, Fatigue and endurance limit, Stress concentration factor, Stress concentration factor for various machine parts, Notch sensitivity, Design for finite and infinite life, Soderberg, Goodman & Gerber criteria.

Riveted Joints: Riveting methods, materials, Types of rivet heads, Types of riveted joints, Caulking and Fullering, Failure of riveted joint, Efficiency of riveted joint, Eccentric loaded riveted joint.

Unit III

Shafts: Cause of failure in shafts, Materials for shaft, Stresses in shafts, Design of shafts subjected to twisting moment, bending moment and combined twisting and bending moments, Shafts subjected to fatigue loads.

Keys and Couplings: Types of keys, splines, Selection of square & flat keys, Strength of sunk key, Couplings, Design of rigid and flexible couplings.

Unit VI

Design of Spur Gears: Conjugate action, involute gears, gear cutting methods, tooth loads, strength of spear gears in bending and in wear. Dynamic loading, Gear materials, design of gears and involute splines. Gear profile corrections, AGMA and Indian standards.

Design of Helical Gears: Tooth relationship, tooth proportions. Design of helical gears, crossed helical gears, AGMA and Indian standards.

Design of Worm and Bevel Gears: Analysis of loads and stresses, power rating, efficiency. Gear standard and proportions.

Unit V

Sliding Contact Bearing: Types, Selection of bearing, Plain journal bearing, Hydrodynamic lubrication, Properties and materials, Lubricants and lubrication, Hydrodynamic journal bearing, Heat generation, Design of journal bearing, Thrust bearing-pivot and collar bearing, Hydrodynamic thrust bearing.

Rolling Contact Bearing: Advantages and disadvantages, Types of ball bearing, Thrust ball bearing, Types of roller bearing, Selection of radial ball bearing, Bearing life, Selection of roller bearings, Dynamic equivalent load for roller contact bearing under constant and variable loading, Reliability of Bearing, Selection of rolling contact bearing, Lubrication of ball and roller bearing, Mounting of bearing.

Note: Design data book is allowed in the examination.

Textbooks:

1. V.B. Bhandari, “Machine Design”, Tata McGraw Hill.
2. P.C. Sharma and D.K Aggarwal., “Machine Design”, S.K. Kataria & Sons.
3. Khurmi and Gupta, “Textbook of Machine Design”, Tata McGraw Hill

Reference books:

1. Maleeve Hartman and O.P.Grover, “Machine Design”, CBS Publication & Publishers.
2. Mahadevan, “Design Data Book”, CBS Publishers & Distributors.
3. J.E. Shigley & C.R. Mischke, "Mechanical Engineering Design”, Tata McGraw Hill Co. Inc.
4. Juvinal R C, Marshek K M, “Fundamentals of Machine component Design”, Wiley India.
5. Norton R. . “Machine Design” Pearson.

Heat and Mass Transfer (BME-602)

L T P C

3 1 2 5

Prerequisite: Basic Knowledge of Thermodynamics and Fluid Mechanics.

Course Outcomes (COs):

After completing this course a student will be able to:

1. Explain the laws of heat transfer, modes of heat transfer and fundamentals Conduction.
2. Mathematically model and analyze the consequence of heat and transfer in thermal analyses of engineering systems and fins concepts.
3. Apply empirical correlations for forced, free convection and phase change process.
4. Formulate, evaluate and develop solution for radiation heat transfer problems in different situations.
5. Understand the consequence of heat transfer in thermal analyses of engineering systems like heat exchanger. Analyze different phenomenon occurring in engineering systems involving mass transfer in steady state.

Course Contents:

UNIT I

Introduction to Heat Transfer: Thermodynamics and Heat Transfer. **Modes of Heat Transfer:** Conduction, convection and radiation. Effect of temperature on thermal conductivity of materials; Introduction to combined heat transfer mechanism.

Conduction: General differential heat conduction equation in the rectangular, cylindrical and spherical coordinate systems. Initial and boundary conditions.

Steady State one-dimensional Heat conduction: Simple and Composite Systems in rectangular, cylindrical and spherical coordinates with and without energy generation; Concept of thermal resistance. Analogy between heat and electricity flow; Thermal contact resistance and over all heat transfer coefficient; Critical radius of insulation.

UNIT II

Fins: Heat transfer from extended surfaces, Fins of uniform cross-sectional area; Errors of measurement of temperature in thermometer wells.

Transient Conduction: Transient heat conduction; Lumped capacitance method; Time constant; Unsteady state heat conduction in one dimension only, Heisler charts.

UNIT III

Forced Convection: Basic concepts; Hydrodynamic boundary layer; Thermal boundary layer; Approximate integral boundary layer analysis; Analogy between momentum and heat transfer in turbulent flow over a flat surface; Mixed boundary layer; Flow over a flat plate; Flow across a

single cylinder and a sphere; Flow inside ducts; Thermal entrance region, Empirical heat transfer relations; Relation between fluid friction and heat transfer; Liquid metal heat transfer.

Natural Convection: Physical mechanism of natural convection; Buoyant force; Empirical heat transfer relations for natural convection over vertical planes and cylinders, horizontal plates and cylinders, and sphere, Combined free and forced convection.

UNIT IV

Thermal Radiation: Basic radiation concepts; Radiation properties of surfaces; Black body radiation Planck's law, Wein's displacement law, Stefan Boltzmann law, Kirchoff's law; ; Gray body; Shape factor; Black-body radiation; Radiation exchange between diffuse non black bodies in an enclosure; Radiation shields; Radiation combined with conduction and convection; Absorption and emission in gaseous medium; Solar radiation; Green house effect.

UNIT V

Heat Exchanger: Types of heat exchangers; Fouling factors; Overall heat transfer coefficient; Logarithmic mean temperature difference (LMTD) method; Effectiveness-NTU method; Compact heat exchangers.

Introduction to Mass Transfer: Introduction; Fick's law of diffusion; Steady state equimolar counter diffusion; Steady state diffusion though a stagnant gas film.

Textbooks:

1. Heat and Mass Transfer by R Yadav, Central Publishing House.
2. Heat and Mass Transfer by R K Rajput.

Reference books:

1. Fundamentals of Heat and Mass Transfer, by Incroperra & DeWitt, John Wiley and Sons.
2. Heat and Mass Transfer by Cengel, McGraw-Hill.
3. Heat Transfer by J.P. Holman, McGraw-Hill.
4. Heat and Mass Transfer by Rudramoorthy and Mayilsamy, Pearson Education.
5. Heat Transfer by Ghoshdastidar, Oxford University Press.
6. A text book on Heat Transfer, by Sukhatme, University Press..
7. Heat Transfer by Venkateshan, Ane Books Pvt Ltd.
8. Schaum's outline of Heat Transfer by Pitts & Sisson McGraw-Hill.

Heat and Mass Transfer Lab (BME-652)

Course Outcomes (COs):

After completing this course a student will be able to:

1. Understand laws of heat transfer, modes of heat transfer and fundamentals of heat exchangers.

2. Mathematically model and analyze the consequence of heat and transfer in thermal analyses of engineering systems.
3. Formulate, evaluate and develop solution for conduction, convection and radiation heat transfer problems in different situations.
3. Apply empirical correlations for forced, free convection and phase change process.
4. Understand, apply principles and analyze mass transfer phenomenon in different processes /systems.

List of Experiment: Minimum 8 experiment of the following

1. Conduction - Composite wall experiment
2. Conduction - Composite cylinder experiment
3. Convection - Pool Boiling experiment
4. Convection - Experiment on heat transfer from tube-natural convection.
5. Convection - Heat Pipe experiment.
6. Convection - Heat transfer through fin-natural convection.
7. Convection - Heat transfer through tube/fin-forced convection.
8. Any experiment - Such as on Stefen's Law, on radiation determination of emissivity, etc.
9. Any experiment - Such as on solar collector, etc. on radiation
10. Heat exchanger - Parallel flow experiment
11. Heat exchanger - Counter flow experiment
12. Any other suitable exp such as on critical insulation thickness.
13. Conduction - Determination of thermal conductivity of fluids.
14. Conduction - Thermal Contact Resistance Effect.

Automobile Engineering (BME-603)

L T P C

3 0 2 4

Prerequisite: Basic Knowledge of I C Engines

Course Outcomes (COs):

After completing this course a student will be able to:

1. Understand the basic requirements from automobile and technology used in them.
2. Demonstrate understanding of different functional systems of automobile such as brakes, suspension system, steering mechanism, gear box and transmission system.
3. Analyze different functional systems of automobiles and the advancements in them.
4. Carry out calculations pertaining to vehicle dynamics.
5. Understand and analyze impact of automobile on environment, different measures and regulations for its control.

Course Contents:

Unit I

Power Unit and Gear Box: Principles of Design of main components. Valve mechanism. Power and Torque characteristics. Rolling, air and gradient Resistance. Tractive effort. Gear Box. Gear ratio determination. Design of Gear box.

Unit II

Transmission System: Requirements. Clutches. Toque converters. over Drive and free wheel, Universal joint. Differential Gear Mechanism of Rear Axle. Automatic transmission, Steering and Front Axle. Castor Angle, wheel camber & Toe in Toe out etc.. Steering geometry. Ackerman mechanism, Understeer and Oversteer.

Unit III

Braking System: General requirements, Road, tyre adhesion, weight transfer, Braking ratio. Mechanical brakes, Hydraulic brakes. Vacuum and air brakes. Thermal aspects.

Chassis and Suspension System: Loads on the frame. Strength and stiffness. Various suspension systems.

Unit IV

Electrical System: Types of starting motors, generator & regulators, lighting system, Ignition system, Horn, Battery etc.

Fuel Supply System: Diesel & Petrol vehicle system such as Fuel Injection Pump, Injector & Fuel Pump, Carburator etc. MPFI.

Unit V

Automobile Air Conditioning: Requirements, Cooling & heating systems

Cooling & Lubrication System: Different type of cooling system and lubrication system.

Maintenance system: Preventive maintenance, break down maintenance, and over hauling system.

Text Books:

1. Automobile Engineering by K M Gupta
2. Automobile Engineering by R K Rajput
3. Automobile Engineering - Kripal Singh.

Reference books:

1. Automotive Engineering- Hietner
2. Automobile Engineering - Narang.
3. Automotive Mechanics- Crouse
4. Automobile Engineering - Newton and Steeds.

Automobile Engineering Lab (BME-653)

Course Outcomes (COs):

After completing this course a student will be able to:

1. Explain the various types of chassis, frame and functions of I C Engine parts.
2. Distinguish between the manual transmissions with automatic transmission systems.
3. Demonstrate how the steering, brakes and the suspension system operate.
4. Justify the importance of alternative fuels.

Note: - Minimum 8 experiments are done. Experiment no 11 is compulsory.

1. Study of braking systems & experiment on vacuum brake.
2. Study of steering systems & experiment on power steering.
3. Study on lubrication and cooling system.
4. Study on five speed gear box and differential gear box.
5. Study of cut section model of multi cylinder petrol and diesel engine.
6. Study of fuel supply system for petrol and diesel engine.
7. Study of front and rear axle assembly.
8. Comparative study of features of common small cars (such as fiat, Ambassador, Maruti, Matiz, Santro, Indica and its variations) available in India.
9. Comparative study of technical features of common scooters & motorcycles available in India.
10. Comparative Study of Technical features of common heavy vehicles available in India.
11. Visit of an Automobile factory.

Departmental Elective Course-II

Unconventional Manufacturing (DE-ME-601)

L T P C

3 0 0 3

Prerequisite: Basic Knowledge of Manufacturing Science

Course Outcomes (COs):

After completion of the course a student will be able to:

1. Understand the process capability of unconventional manufacturing process.
2. Understand various non-conventional manufacturing processes.
3. Develop competency to selecting various un-conventional manufacturing processes.
4. Explain the working principles of thermal energy based processes.
5. Understand the Diffusion and Photo- Lithography process for electronic-device.

Course Contents:

Unit I

Introduction: Limitations of conventional manufacturing processes need of unconventional manufacturing processes & its classification and its future possibilities.

Unit II

Unconventional Machining Process: Principle and working and applications of unconventional machining process such as Electro-Discharge machining, electrochemical machining, ultrasonic machining, Abrasive jet machining etc.

Unit III

Unconventional Machining Process (continued): Principle and working and application of unconventional machining processes such as Laser beam machining, Electron beam machining, Ultrasonic machining etc. (these can also be used for welding).

Unit IV

Unconventional welding processes: Explosive welding, Cladding etc. Under water welding, Metalizing, Plasma are welding/cutting etc.

Unit V

Unconventional Forming processes: Principle, working and applications of High energy forming processes such as Explosive Forming, Electromagnetic forming, Electro-Discharge forming, water hammer forming, explosive compaction etc.

Electronic-device Manufacturing: Brief description of Diffusion and Photo- Lithography process for electronic-device manufacturing.

Books

1. Unconventional Machining – V.K. Jain

Reference Books:

1. Modern Machining Processes – P.C. Pandey.

Experimental Stress Analysis (DE-ME-602)

L T P C

3 0 0 3

Prerequisite: Basic Knowledge of Engineering Mechanics and Mechanics of Solids.

Course Outcomes (COs):

After completing this course a student will be able to:

1. Analyse the 3-D state of stress in components with application of plane stress and plane strain conditions.
2. Analyse 3D state of strain in the components.
3. Understand various practical methods of analyzing strain in the components.
4. Understand the parameters, and practical applications of strain gages.
5. Understanding various aspects of photo elasticity and its application for stress analysis.

Course Contents:

UNIT I

Elementary Elasticity: Stress: Introduction, Stress Equations of Equilibrium, Laws of Stress Transformations, principal Stresses, Two-Dimensional State of Stress, Stresses Relative to Principal Coordinate System, Special States of Stress.

Strain: Introduction, Displacement and Strain, Strain Transformation Equation, Principal Strains, Compatibility, Volume Dilation, Stress Strain Relations, Strain Transformation Equations and Stress Strain Relations for Two-Dimensional State of Stress.

UNIT II

Strain Measurements: Introduction, Properties of Strain Gage Systems, Types of Strain Gages, Grid- Method of Strain Analysis.

Brittle Coating Method: Coating Stresses, Failure Theories, Brittle Coating Crack Patterns, Resin and Ceramic Based Brittle Coating, Test Procedure, Analysis of Brittle Coating Data.

UNIT III

Electrical Resistance Strain Gages: Introduction, Strain Sensitivity in Alloys, Strain Gage Adhesives, Gage Sensitivity and Gage Factor.

Strain Gage Circuit: Potentiometer and its Application, Wheat-Stone Bridge, Bridge Sensitivity, Null Balance Bridges.

Analysis of Strain Gage Data: Three Element Rectangular Rosette, Delta Rosette, Stress Gage, Plane Shear-Gage.

UNIT IV

Theory of Photo elasticity: Introduction, Temporary Double Refraction, Stress Optic Law, Relative Retardation, Stressed Model in Plane Polariscope, Effect of Principal Directions, Effect of

Principal Stress Difference, Stressed Model in Circular Polariscope, Light and Dark Field arrangements, Tardy Compensation, Fringe Sharpening and Multiplication by Partial Mirrors.

UNIT V

Two Dimensional Photo elasticity: Introduction, Isochromatic Fringe Patterns, Isoclinic Fringe Patterns, Compensation Techniques, Calibration Methods, Separation Methods, Shear Difference Method, Electrical Analogy Method, Oblique Incidence Method, Materials for Two-Dimensional Photoelasticity.

Text Books:

1. Experiment Stress Analysis by Dr. Sadhu Singh, Khanna Publishers.

Reference Books:

1. Experiment Stress Analysis by James W. Dally and William F. Riley, International Student Edition, McGraw-Hill Book Company.

Reliability and Maintenance Engineering (DE-ME-603)

L T P C

3 0 0 3

Prerequisite: Basic Knowledge of Power Plant Engineering.

Course Outcomes (COs):

After completion of this course student will be able to:

1. Explain maintenance objectives and functions, need for maintenance plan and organization, and cost of maintenance, equipment and production delays.
2. Understand equipment wear records and standards and various kinds of NDT methods for predictive maintenance.
3. Explain maintenance of mechanical drives such as belt drive, chain drive and gears
4. Understand the maintenance of pumps, compressors and control valves.
5. Explain the principles and techniques applicable in life testing and reliability improvements.

Course Contents:

UNIT I

Introduction to maintenance: Need for maintenance. Types of maintenance, breakdown, corrective and preventive maintenance. Maintenance planning, Scheduled maintenance. Cost of maintenance versus Cost of equipment and production delays. Inspection: Inspection intervals, Inspection reports, card history system.

UNIT II

Predictive maintenance: Equipment wear records, standards. Equipment used in predictive maintenance. Computerized maintenance. The role of computers in a maintenance programme. Types if lubrication system and selection of lubricants. Non-destructive testing: Liquid Penetrate, Magnetic particles, Ultrasonic testing, and Vibration analysis. Oil analysis Radiographic testing.

UNIT III

Maintenance of mechanical drives: Bearings: Overheating, noise, vibration. Chain drives: Normal wear in chain drives. Tension in chain drives, Sprockets: Lubrication, Belt drives: Tension in belts, slip &creep. Gears: Normal wear in gears, Lubrication &alignment problems. Shock, overloading. Couplings: Rigid flexible couplings.

UNIT IV

Maintenance of fluid power systems: Pumps: Noise& heat, Compressors: Heating, noise, vibration problems. Maintenance of Control valves.

UNIT V

Life testing-reliability: Life testing-Objectives-failure data analysis, Mean failure rate, mean time to failure, mean time between failures, hazard rate, system reliability: series &parallel and mixed

configuration-simple problems. Maintainability and availability. Reliability of acceptance sampling based on reliability test-O. C Curves.

Quality and reliability: Reliability improvements-techniques, use of Pareto analysis-Design for reliability, redundancy unit and stand by redundancy, Optimization of reliability.

Text Books:

1. Stainer, Plant Engg Hand Book"
2. Morrow, Maintenance Engg Hand Book"

Reference Books:

1. Terry Wireman, "Preventive Maintenance", Reston Publishing Company, Prentice Hall.
2. Miller & Blood, Modern Maintenance Management".

Additive Manufacturing (DE-ME-604)

L T P C

3 0 0 3

Prerequisite: Basic Knowledge of Computer Aided Design.

Course Outcomes (COs):

After completion of this course student will be able to:

1. Describe various CAD issues for 3D printing and rapid prototyping and related operations for STL model manipulation.
2. Formulate and solve typical problems on reverse engineering for surface reconstruction from physical prototype models through digitizing and spline based surface fitting.
3. Formulate and solve typical problems on reverse engineering for surface reconstruction from digitized mesh models through topological modelling and subdivision surface fitting.
4. Explain and summarize the principles and key characteristics of additive manufacturing technologies and commonly used 3D printing and additive manufacturing systems.
5. Explain and summarize typical rapid tooling processes for quick batch production of plastic and metal parts.

Course Contents:

UNIT I

Introduction: Prototyping fundamentals, Historical development, Fundamentals of Rapid Prototyping, Advantages, and Limitations of Rapid Prototyping, Commonly used Terms, Classification of RP process, Rapid Prototyping Process Chain: Fundamental Automated Processes, Process Chain.

UNIT II

Liquid-based Rapid Prototyping Systems: Stereo lithography Apparatus (SLA): Models and specifications, Process, working principle, photopolymers, photo polymerization, Layering technology, laser and laser scanning, Applications, Advantages and Disadvantages, Case studies. **Solid ground curing (SGC**): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies Solid-based Rapid Prototyping Systems: Laminated **Object Manufacturing (LOM):** Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Fused Deposition Modeling (FDM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies.

UNIT III

Powder Based Rapid Prototyping Systems: Selective laser sintering (SLS): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case

studies. **Three-dimensional Printing (3DP):** Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. **Rapid Tooling**: Introduction to Rapid Tooling (RT), Conventional Tooling Vs RT, Need for RT. Rapid Tooling Classification; **Indirect Rapid Tooling Methods:** Spray Metal Deposition, RTV Epoxy Tools, Ceramic tools, Investment Casting, Spin Casting, Die casting, Sand Casting, 3D Keltool process. Direct Rapid Tooling: Direct AIM, LOM Tools, DTM Rapid Tool Process, EOS Direct Tool Process and Direct Metal Tooling using 3DP

UNIT IV

Rapid Prototyping Data Formats: STL Format, STL File Problems, Consequence of Building Valid and Invalid Tessellated Models, STL file Repairs: Generic Solution, Other Translators, Newly Proposed Formats. **Rapid Prototyping Software's**: Features of various RP software's like Magics, Mimics, Solid View, View Expert, 3 D View, Velocity 2, Rhino, STL View 3 Data Expert and 3 D doctor.

UNIT V

Rapid prototyping Applications: Application - Material Relationship, Application in Design, Application in Engineering, Analysis and Planning, Aerospace Industry, Automotive Industry, Jewelry Industry, Coin Industry, GIS application, Arts and Architecture. RP Medical and Bioengineering Applications: Planning and simulation of complex surgery, Customized Implants & Prosthesis, Design and Production of Medical Devices, Forensic Science and Anthropology, Visualization of Biomolecules.

Text Books:

1. Rapid prototyping; Principles and Applications /Chua C.K., Leong K.F. and LIM C.S/World Scientific Publications.
2. Rapid Manufacturing /D.T. Pham and S.S. Dimov/Springer

Reference Books:

1. Terry Wohlers, Wholers Report 2000, Wohlers Associates.
2. Rapid Prototyping and Manufacturing /PaulF.Jacobs/ASME.

Open Elective Course II

Composite Materials (OE-ME-601)

L T P C

3 0 0 3

Prerequisite: Basic Knowledge of Materials Science.

Course Outcomes (COs):

1. Knowledge of the different types of engineering materials.
2. Knowledge of the types of reinforcements and fibers.
3. Understand the various types of composites used in engineering and their properties.
4. Describe the processing of composite materials and manufacturing techniques.
5. Understand and analyze the various methods of testing the composites.

Course Contents:

UNIT I

Introduction: Classifications of Engineering Materials, Concept of composite materials, Matrix materials, Functions of a Matrix, Desired Properties of a Matrix, Polymer Matrix (Thermoset sand Thermoplastics), Metal matrix, Ceramic matrix, Carbon Matrix, Glass Matrix etc.

UNIT II

Types of Reinforcements/Fibers: Role and Selection of reinforcement materials, Types of fibers, Glass fibers, Carbon fibers, Aramid fibers, Metal fibers, Alumina fibers, Boron Fibers, Silicon carbide fibers, Quartz and Silica fibers, Multiphase fibers, Whiskers, Flakes etc. Mechanical properties of fibres. Material properties that can be Improved by forming a composite material and its engineering potential.

UNIT III

Various types of composites: Classification based on Matrix Material: Organic Matrix composites, Polymer matrix composites (PMC),Carbon matrix Composites or Carbon-Carbon Composites, Metal matrix composites (MMC), Ceramic matrix composites (CMC);Classification based on reinforcements: Fiber Reinforced Composites, Fiber Reinforced Polymer(FRP) Composites, Laminar Composites, Particulate Composites.

UNIT IV

Fabrication methods: Processing of Composite Materials: Overall considerations, Auto clavecuring, Other Manufacturing Processes like filament welding, compression moulding, resin transplant method, pultrusion, pre-peg layer, Fiber-only performs, Combined Fiber-Matrix performs, Manufacturing Techniques: Tooling and Specialty materials, Release agents, Peelplies, release films and fabrics, Bleeder and breather plies, bagging films, maximum stress and strain criteria, Von Mises Yield criterion for isotropic materials.

UNIT V

Testing of Composites and Analysis: Mechanical testing of composites, tensile testing, Compressive testing, Intra-laminar shear testing, Inter-laminar shear testing, Fracture testing etc. Analysis of laminated plates- equilibrium equations of motion, energy formulation, static bending analysis, buckling analysis, free vibrations, natural frequencies.

Text Books:

1. Mechanical Metallurgy, by G. Dieter, McGraw Hill.
2. Engineering Materials: Polymers, Ceramics and Composites, by A.K Bhargava Prentice Hall India.
3. Analysis and Performance of Fiber Composites, by Agarwal, McGraw Hill.

Reference Books:

1. Materials characterization, Vol. 10, ASM hand book.
2. Thermal Analysis of Materials, by R.F. Speyer, Marcel Decker.
3. Engineering Mechanics and Composite Materials, by Daniels, Oxford University Press.
4. Material Science and Engineering (SIE) with CD, by Smith, McGraw Hill.
5. Gibson R.F. Principles of Composite Material Mechanics, second edition, McGraw Hill, 1994.

Entrepreneurship (OE-ME-602)

L T P C

3 0 0 3

Prerequisite: Basic Knowledge of industrial management.

Course Outcomes (COs):

1. Understand entrepreneurship and its related theory and government policies
2. Understand various Business Enterprises and Ownership Structure
3. Prepare project report and able to understand project evaluation method.
4. Understand various strategies and policies in management and enterprises.
5. Understand Institutional support towards the development of entrepreneurship.

Course Contents:

Unit I

Entrepreneurship: Definition, requirements to be an entrepreneur, entrepreneur and intrapreneur, entrepreneur and manager, growth of entrepreneurship in India, women entrepreneurship, rural and urban entrepreneurship.

Entrepreneurial Motivation: motivating factors, motivation theories-Maslow's Need Hierarchy Theory, McClelland's Acquired Need Theory, government's policy actions towards entrepreneurial motivation, entrepreneurship development programme.

Unit II

Business Enterprises and Ownership Structure Small scale, medium scale and large scale enterprises, role of small enterprises in economic development; proprietorship, partnership, companies and co-operatives firms: their formation, capital structure and source of finance.

Unit III

Project Management: Identification and selection of projects; project report: contents and formulation, concept of project evaluation, methods of project evaluation: internal rate of return method and net present value method.

Unit IV

Management of Enterprises: Strategy & policy, introduction to human resource management, marketing strategies, financial management & strategies: raising and managing capital, shares, debentures and bonds, cost of capital; break- even analysis.

Unit V

Institutional Support and Policies: Institutional support towards the development of entrepreneurship in India: Institutional framework, venture capitalist; technical consultancy organizations (TCOs), government policies for small scale enterprises.

Text Books:

1. Khanka, S S. 'Entrepreneurial Development', S Chand & Company Ltd. New Delhi.
2. Desai, Vasant, 'Project Management and Entrepreneurship', Himalayan Publishing House, Mumbai, 2002.
3. Gupta and Srinivasan, 'Entrepreneurial Development', S Chand & Sons, New Delhi.

Reference Books:

1. Ram Chandran, 'Entrepreneurial Development', Tata McGraw Hill, New Delhi
2. Saini, J. S. 'Entrepreneurial Development Programmes and Practices', Deep & Deep Publications (P), Ltd.
3. Holt, Davis, 'Entrepreneurship: New Venture Creations, PHI.

Mechanical System Design (OE-ME-603)

L T P C

3 0 0 3

Prerequisite: Basic Knowledge of Industrial Engineering.

Course Outcomes (COs):

After completing this course a student will be able to:

1. Understand the attributes characterizing a system and case study.
2. Explain the system modelling and case study compound bar system.
3. Differentiate and understand the graph modelling, graph analysis and materials handling systems.
4. Understand the method for optimization model with single system.
5. Justify the inventory control in production plant.

Course Contents:

UNIT I

Engineering process and System Approach Basic concepts of systems, Attributes characterizing a system, types of system, Application of system concepts, Advantages of system approach, Problems concerning systems, Concurrent engineering, A case study-Viscous lubrication system in wire drawing.

Problem Formulation: Nature of engineering problems, Need statement, hierarchical nature of systems, hierarchical nature of problem environment, problem scope and constraint, A case study: heating duct insulation system, high speed belt drive system.

UNIT II

System Theories: Introduction, System Analysis, Black box approach, state theory approach, component integration approach, Decision process approach, A case study- automobile instrumentation panel system.

System modeling Introduction, Model types and purpose, linear systems, mathematical modeling, concepts, A case study compound bar system.

UNIT III

Graph Modeling and Analysis Graph Modeling and analysis process, path problem, Network flow problem, A case study: Material handling system.

Optimization Concepts Optimization processes, Selection of goals and objectives-criteria, methods of optimization, analytical, combinational, subjective. A case study: aluminum extrusion system.

UNIT IV

System Evaluation Feasibility assessment, planning horizon, time value of money, Financial analysis, A case study: Manufacture of maize starch system. 4 Calculus Method for Optimization

Model with single decision variable, model with two decision variables, model with equality constraints, model with inequality constraints, A case study: Optimization of an insulation system.

UNIT V

Decision Analysis Elements of a decision problem, decision making, under certainty, uncertainty risk and conflict probability, density function, Expected monetary value, Utility value, Baye's theorem, A case study: Installation of machinery. 4 System Simulation Simulation concepts, simulation models, computer application in simulation, spread sheet simulation, Simulation process, problem definition, input model construction and solution, limitation of simulation approach, A case study: Inventory control in production plant.

Text Books:

1. Engineering Design, by Dieter, McGraw Hill.
2. Optimization Techniques-SS Rao.
3. Design Engineering-JR Dixon, TMH, New Delhi.
4. Engineering Design-Robert Matousck, Blackie and son ltd. Glasgow.

Reference Books:

1. An Introduction to Engineering Design Method-V Gupta and PN Murthy, TMH, New Delhi.
2. Design and Planning of Engineering systems-DD Reredith, KV Wong, RW Woodhead, and RR Worthman, Prentice Hall Inc., Eaglewood Cliffs, New Jerse.
3. System Analysis and Project Management-Devid I Cleland, William R King, McGraw Hill.

Product Design and Development (OE-ME-604)

L T P C

3 0 0 3

Prerequisite:

Course Outcomes (COs):

After completing this course a student will be able to:

1. Understand how to create new product based on mechanical design engineering.
2. Understand all mechanical aspects of product design by incorporating concept, creativity, structural, manufacturing, esthetic etc.
3. Solve open-ended problem belongs to design engineering that meet the requirements.
4. Understand various product designing methods.
5. Understand human factors and cost evaluation in industrial design concepts.

Course Contents:

Unit I

Design Fundamentals:

The importance of engineering design – types of design –the design process – relevance of product lifecycle issues in design –designing to codes and standards- societal considerations in engineering design –generic product development process – various phases of product development-planning for products –establishing markets- market segments- relevance of market research.

Unit II

Customer oriented design & Societal Considerations: Identification of customer needs- customer requirements- Quality Function Deployment Product Design Specifications- Human Factors in Design – Ergonomics and Aesthetics. Societal consideration - Contracts – Product liability – Protecting intellectual property – Legal and ethical domains – Codes of ethics - Ethical conflicts – Environment responsible design-future trends in interaction of engineering with society.

Unit III

Material selection processing and Design: Material Selection Process – Economics – Cost Vs Performance – Weighted property Index – Value Analysis – Role of Processing in Design – Classification of Manufacturing Process – Design for Manufacture – Design for Assembly – Designing for castings, Forging, Metal Forming, Machining and Welding – Residual Stresses – Fatigue, Fracture and Failure.

Unit IV

Design Methods: creativity and problem solving- creative thinking methods- generating design concepts - systematic methods for designing –functional decomposition – physical decomposition –

functional representation – morphological methods-TRIZ- axiomatic design. Decision making theory- utility theory –decision trees –concept evaluation methods.

Unit V

Industrial Design concepts: Human factors design –user friendly design – design for serviceability – design for environment – prototyping and testing – cost evaluation –categories of cost –overhead costs – activity based costing – methods of developing cost estimates – manufacturing cost –value analysis in costing.

Text books:

1. Product Design & Manufacturing by A. K. Chitab & R. C. Gupta, PHI (EEE).
2. Product Design and Development by Karl T Ulrich, Steven D. Eppinger.
3. Product Design, by Kevin Otto, Kristin wood, Pearson Education Inc.

Reference books:

1. The Technology of Creation Thinking by R.P. Crew ford, Prentice Hall.
2. The Art of Thought by Grohem Walls, Bruce & Co., New York.
3. Product Design & Decision Theory by M.K. Starr, Prentice Hall.
4. Human Factor Engg. by Mccormick E.J., McGrawHill.
5. Engineering: An Introduction to Creative profession by G.C. Beakley, H.W. Leach, Macmillan.
6. Industrial Design In Engineering – A marriage of Techniques by Charles H. Flurscheim, The Design Council - London.
7. Quality Control & Reliability Analysis by Bijendra Singh, Khanna Publications.

Economics for Industry (BHSM-601)

L T P C

3 0 0 3

Prerequisite: Basic knowledge of economics.

Course outcomes (COs):

At the end of the course, the students will be able to:

1. Define the main concepts and describe the models and methods in economic analysis.
2. Explain economic events in individual markets and the aggregate economy using basic theory and tools.
3. Apply supply and demand analysis to relevant economic issues.
4. Explain how individual decisions and actions as a member of society affect the economy locally, nationally and internationally.
5. Distinguish between perfect competition and imperfect competition and explain the welfare loss in non-competitive markets.

Course Contents:

UNIT I

Introduction of Engineering Economics and Demand Analysis: Meaning and nature of Economics, Relation between science, engineering, technology and economics; Meaning of Demand, Determinants of Demand, Shifts in demand, Law of Demand, Price Elasticity of Demand &Types, Income Elasticity, Cross price Elasticity, Determinants of Elasticity, uses and importance of elasticity.

UNIT II

Concept of Supply: Law of Supply, Factors affecting Supply, Elasticity of supply.

Demand Forecasting: Introduction, Meaning and Forecasting, Methods or Techniques of Demand Forecasting, Criteria for Good Demand Forecasting, Demand Forecasting for a New Product;

UNIT III

Cost Analysis: Introduction, Types of Costs, Cost-Output Relationship: Cost Function, Cost-Output Relationships in the Short Run, and Cost-Output Relationships in the Long Run; Short run and long run, Break- Even Analysis; Production functions: laws of variable proportions, law of returns; Economies of scale: Internal and external.

UNIT IV

Market Structure: Market Structure Perfect Competition, Imperfect competition – Monopolistic, Oligopoly, duopoly sorbent features of price determination and various market conditions.

UNIT V

Nature and characteristics of Indian economy, concepts of LPG, elementary concepts of National Income, Inflation and Business Cycles, Concept of N.I. and Measurement., Meaning of Inflation,

Types and causes , Phases of business cycle .Investment decisions for boosting economy(National income and per capital income)

Textbooks:

1. Koutsoyiannis A, “Modern Microeconomic”, Macmillan Education Ltd.
2. Dwivedi DN, “Principles of Microeconomics”, Pearson Education.
3. Premvir Kapoor, Sociology and Economics for Engineers, Khanna Publishing House (Edition 2018).

Reference books:

1. Salvatore D, “Principles of Microeconomics”, Oxford University Press.
2. Cowell, FA, “Microeconomic Principles and Analysis”, Oxford University Press.

Mechanical Vibration (BME-701)

L T P C

3 0 2 4

Prerequisite: Basic Knowledge of Engineering Mathematics.

Course Outcomes (COs):

After completing this course a student will be able to:

1. Understand the basic concepts of vibrations.
2. Develop analyze the one degree to multi-degree of freedom vibration problems.
3. Understand the vibration control mechanisms and systems.
4. Practice the numerical techniques used for solving the vibrational models of mechanical systems.
5. Analysis of different method such as Rayleigh's, Dunkerley's, and Critical Speed of shaft with one disc with and without damping.

Course Contents:

UNIT I

Introduction: Periodic motion, harmonic motion, superposition of simple harmonic motions, beats, Fourier analysis.

Single Degree Freedom System: Free vibration, Natural frequency, Equivalent systems, Energy method for determining natural frequency, response to an initial disturbance, Torsional vibrations, Damped vibrations, Vibrations of systems with viscous damping, Logarithmic decrement.

UNIT II

Single Degree Freedom: Forced Vibration: Forced vibration, Harmonic excitation with viscous damping, steady state vibrations, Forced vibrations with rotating and reciprocating unbalance, Support excitation, Vibration isolation, Transmissibility, Vibration measuring instruments, Displacement, velocity and acceleration measuring instruments

UNIT III

Two Degree Freedom systems: Introduction, Principal modes, Double pendulum, Torsional system with damping, coupled system, undamped dynamic vibration absorbers, Centrifugal pendulum absorbers, Dry friction damper.

UNIT IV

Multi Degree Freedom system: Exact Analysis: Undamped free and forced vibrations of multi degree freedom systems, influence number, Reciprocal theorem, Torsional vibration of multi degree rotor system, Vibration of gear system, Principal coordinates, Continuous systems- Longitudinal vibrations of bars, Torsional vibrations of circular shafts.

UNIT V

Multi Degree Freedom system: Numerical Analysis: Rayleigh's, Dunkerely's, Holzer's and Stodola methods, Rayleigh-Ritz method.

CRITICAL SPEED OF SHAFTS: Shaft with one disc with and without damping, Multi-disc shafts, Secondary critical speed.

Text Books:

1. Mechanical Vibrations – G. K. Groover, Jain Brothers, Rooekee.
2. Mechanical Vibrations – JS Rao & K Gupta, New Age.
3. Mechanical Vibration by S S Rao.

Reference Books:

1. Mechanical Vibrations – P. Srinivasan, TMH.
2. Mechanical Vibrations – W. T. Thomson.
3. Mechanical Vibrations – Tse, Morse & Hinkle.
4. Mechanical Vibrations – V. Rama Murthy, Narosa Publications.

Mechanical Vibration Lab (BME-751)

Course Outcomes (COs):

After completing this course a student will be able to:

1. Understand the basic concept of pendulum.
2. Explain analyze the one degree vibration problems.
3. Understand the forced vibration of spring mass system.
4. Solving the vibrational models of mechanical systems.
5. Analysis of Torsional Vibration.

Note: List of Experiments (Any 8 Experiments)

1. To verify the relation simple pendulum.
2. To determine the radius of gyration of compound pendulum.
3. To determine the radius of gyration & moment of inertia of bi-filar suspension.
4. To study the undamped torsional vibration of single rotor system.
5. To Study the undamped torsional vibrations of double rotor system.
6. To study the longitudinal vibration of helical coiled spring.
7. To study the undamped forced vibration of spring mass system.
8. To study the force damped vibration of spring mass system.
9. To study the undamped forced vibration of simply supported beam.
10. To study the damped forced vibration of simply supported beam.
11. To Study about the torsional vibration.

Advanced Welding Technology (BME-702)

L T P C

2 0 0 2

Prerequisite: Basic Knowledge of Workshop Technology and Manufacturing Science.

Course Outcomes (COs):

After completing this course a student will be able to:

1. Understand the theoretical and practical aspects of welding and it's phenomena.
2. Understand the various welding process.
3. Describe the basic metallurgy of the melted and heat affected zone of a metal or alloy and heat transfer involved in different welding process.
4. Understand the various process involved in repair and maintenance of welding and the weldability of different metal.
5. Demonstrate their ability to check the weldment quality using various inspection and testing methods.

Course Contents:

Unit I

Introduction: Welding as compared with other fabrication processes, Importance and application of welding, classification of welding processes, Health & safety measures in welding.

Welding Power Sources: Physics of welding Arc, Basic characteristics of power sources for various arc welding processes, Transformer, rectifier and generators. Physics of Welding Arc: Welding arc, arc initiation, voltage distribution along the arc, arc characteristics, arc efficiency, heat generation at cathode and anode, Effect of shielding gas on arc, isotherms of arcs and arc blow. Metal Transfer: Mechanism and types of metal transfer in various arc welding processes.

Unit II

Welding Processes: Manual Metal Arc Welding (MMAW), TIG, MIG, Plasma Arc, Submerged Arc Welding, Electro gas and Electro slag, Flux Cored Arc Welding, Resistance welding, Friction welding, Brazing, Soldering and Braze welding processes, Laser beam welding, Electron beam welding, Ultrasonic welding, Explosive welding, Friction Stir Welding, Underwater welding & Microwave welding.

Unit III

Heat Flow Welding: Calculation of peak temperature; Width of Heat Affected Zone (HAZ);cooling rate and solidification rates; weld thermal cycles; residual stresses and their measurement; weld distortion and its prevention.

Unit IV

Repair & Maintenance Welding: Hard facing, Cladding, Surfacing, Metallizing processes and Reclamation welding.

Weldability: Effects of alloying elements on weld ability, welding of plain carbon steel, Cast Iron and aluminium. Micro & Macro structures in welding.

Unit V

Weld Design: Types of welds & joints, Joint Design, Welding Symbols, weld defects, Inspection/testing of welds, Introduction to Welding Procedure Specification & Procedure Qualification Record.

Text Books:

1. Little R.L., "Welding and welding Technology", Tata McGraw Hill Publishing Co., Ltd., New Delhi, 34th reprint, 2008.
2. Parmer R.S., "Welding Engineering and Technology", 1st Edition, Khanna Publishers, New Delhi, 2008.
3. Parmer R.S., "Welding Processes and Technology", Khanna Publishers, New Delhi, 1992.

Reference Books:

1. AWS- Welding Hand Book. 8th Edition. Vol- 2. "Welding Process".
2. Christopher Davis. "Laser Welding- Practical Guide". Jaico Publishing House.
3. Davis A.C., "The Science and Practice of Welding", Cambridge University Press, Cambridge, 1993.
4. Nadkarni S.V. "Modern Arc Welding Technology", Oxford IBH Publishers, 1st Edition, 2005.
5. Schwartz M.M. "Metals Joining Manual". McGraw Hill Books, 1979.
6. Tylecote R.F. "The Solid Phase Welding of Metals". Edward Arnold Publishers Ltd. London.

Departmental Elective-III

Refrigeration and Air Conditioning (DE-ME-701)

L T P C

3 0 2 4

Prerequisite: Basic Knowledge of Engineering Thermodynamics.

Course Outcomes (COs):

After completing this course a student will be able to:

1. Illustrate the fundamental principles and applications of refrigeration and air conditioning system.
2. Analyse performance of vapor compression refrigeration system.
3. Study the working principles of vapor absorption system and different refrigerants used.
4. Analyse the air conditioning processes using principles of Psychrometry.
5. Study the different refrigeration equipment's and its application in cold storage ,ice plant.

Course Contents:

Unit I

Refrigeration: Introduction to refrigeration system, Methods of refrigeration, Carnot refrigeration cycle, Unit of refrigeration, Refrigeration effect & C.O.P.

Air Refrigeration cycle: Open and closed air refrigeration cycles, Reversed Carnot cycle, Bell Coleman or Reversed Joule air refrigeration cycle, Aircraft refrigeration system, Classification of aircraft refrigeration system. Boot strap refrigeration, Regenerative, Reduced ambient, Dry air rated temperature (DART).

Unit II

Vapour Compression System: Single stage system, Analysis of vapour compression cycle, Use of T-S and P-H charts, Effect of change in suction and discharge pressures on C.O.P, Effect of sub cooling of condensate & superheating of refrigerant vapour on C.O.P of the cycle, Actual vapour compression refrigeration cycle, Multistage vapour compression system requirement, Removal of flash gas, Intercooling.

Unit III

Vapour Absorption system: Working Principal of vapour absorption refrigeration system, Comparison between absorption & compression systems, Elementary idea of refrigerant absorbent mixtures, Temperature – concentration diagram & Enthalpy – concentration diagram , Adiabatic mixing of two streams, Ammonia – Water vapour absorption system, Lithium- Bromide water vapour absorption system, Comparison. Three fluid system.

Refrigerants: Classification of refrigerants, Nomenclature, Desirable properties of refrigerants, Common refrigerants, Secondary refrigerants and CFC free refrigerants. Ozone layer depletion and global warming considerations of refrigerants.

Unit IV

Air Conditioning: Introduction to air conditioning, Classification of air conditioning system, Comfort air conditioning, Industrial air conditioning, Winter air conditioning, Summer air conditioning, Unitary and central air conditioning System. Psychometric properties and their definitions, Psychometric chart, Different Psychometric processes, Effective temperature and comfort chart, Cooling and heating load calculations, Sensible heat factor (SHF), By pass factor, Grand Sensible heat factor (GSHF), Apparatus dew point (ADP). Air Washers, Cooling towers.

Unit V

Refrigeration Equipment & Application: Elementary knowledge of refrigeration & air conditioning equipment's compressors, condensers, evaporators & expansion devices, Food preservation, Cold storage, Refrigerates Freezers, Ice plant, Water coolers, Elementary knowledge of transmission and distribution of air through ducts and fans.

Text Books:

1. Refrigeration and Air conditioning by C.P Arora, McGraw-Hill.
2. Refrigeration and Air conditioning, by Manohar Prasad, New Age International (P) Ltd. Publication.
3. Refrigeration and Air conditioning by R. C. Arora, PHI.

Reference Books:

1. Principles of Refrigeration by Roy J. Dossat. Pearson Education.
2. Refrigeration and Air conditioning by stoecker & Jones. McGraw-Hill.
3. Refrigeration and Air conditioning by Arora & Domkundwar. Dhanpat Rai.
4. Thermal Environment Engg. By Kuhen, Ramsey & Thelked.

Refrigeration and Air Conditioning Lab (DE-ME-751)

Course Outcomes (COs):

After completing this course a student will be able to:

1. Understand the concept of refrigeration test rig and its applications.
2. Understand the concept of different types of expansion devices and its application.
3. Remembering concept of evaporators in refrigeration systems.
4. Learn and use of condensers.
5. Analyze the basic components of air conditioning system.
6. To study basic components of air-conditioning system.
7. Evaluate the various performance parameters use in refrigeration test rig.

8. Understand the concept of air washer and window air conditioner.

Minimum eight experiments out of the following:

1. Experiment on refrigeration test rig and calculation of various performance parameters.
2. To study different types of expansion devices used in refrigeration system.
3. To study different types of evaporators used in refrigeration systems.
4. To study different types of condensers.
5. To study basic components of air-conditioning system.
6. Experiment on air-conditioning test rig & calculation of various performance parameters.
7. To study air washers.
8. Study of window air conditioner.
9. Experiment on Ice-plant.
10. Study of Hermetically sealed double stag compressor.
11. Experiment on Desert coolers.

VISIT: Visit of a central air conditioning plant / cold-storage and its detailed study or a minor project related to any topic on course of Refrigeration and air conditioning.

Design and Analysis of Heat Exchangers (DE-ME-702)

L T P C

3 0 2 4

Prerequisite: Basic Knowledge of Heat and Mass Transfer.

Course Outcomes (COs):

After completing this course a student will be able to:

1. Understand LMTD method and NTU method of analysis of common types of heat exchangers.
2. Understand the method to design of heat exchangers subject to fouling.
3. Understand the design procedure of double pipe heat exchangers and Shell & tube heat exchangers.
4. Understand the designing aspects of compact heat exchangers and thermal design of shell & tube condensers.
5. Describe the thermal analysis of evaporator and understand performance evaluation of Heat transfer Enhancement technique.

Course Contents:

Unit I

Basic design methodologies: Classification of heat exchanger, selection of heat exchanger, Thermal-Hydraulic fundamentals, Overall heat transfer coefficient, LMTD method for heat exchanger analysis for parallel, counter, multipass and cross flow heat exchanger, e-NTU method for heat exchanger analysis, Fouling, Rating and sizing problems, heat exchanger design methodology.

Unit II

Fouling of heat exchangers: Basic consideration, effect of fouling on heat transfer and pressure drop, cost of fouling, design of heat exchangers subject to fouling, fouling resistance, cleanliness factor, techniques to control fouling.

Unit III

Design of double pipe heat exchangers: Thermal and Hydraulic design of inner tube and annulus, hairpin heat exchanger with bare and finned inner tube, total pressure drop.

Design of Shell & tube heat exchangers: Basic components, basic design procedure of heat exchanger, TEMA code, J-factors, conventional design methods, Bell-Delaware method.

Unit IV

Design of compact heat exchangers: Heat transfer enhancement, plate fin heat exchanger, tube fin heat exchanger, heat transfer and pressure drop.

Condenser: Shell and tube condenser, plate condenser, air cooled condenser, direct contact condenser, condenser for refrigeration and air-conditioning, thermal design of shell and tube condenser.

Unit V

Evaporator: Evaporator for refrigeration and air-conditioning, thermal analysis of evaporator, standards for evaporators and condensers.

Heat transfer enhancement and performance evaluation: Enhancement of heat transfer, Performance evaluation of Heat Transfer Enhancement technique. Introduction to pinch analysis

Text Books:

1. Heat Exchanger Selection, Rating and Thermal Design by Sadik, Kakac, CRC Press.
2. Fundamentals of Heat Exchanger Design by Ramesh K Shah, Wiley Publication

Reference Books:

1. Compact Heat Exchangers by Kays, V.A. and London, A.L., McGraw Hill.
2. Heat Exchanger Design Handbook by Kuppan, T, Macel Dekker, CRC Press.
3. Heat Exchanger Design Hand Book by Schunder E.U., Hemisphere Publication.
4. Process Heat transfer by Donald Q Kern, McGraw Hill

Design and Analysis of Heat Exchangers Lab (DE-ME-752)

Course Outcomes (COs):

After completing this course a student will be able to:

1. Understand the concept of LMTD method and Applications.
2. Understand the concept effectiveness-NTU method and Applications.
3. Understand the concept and analysis of double pipe heat exchanger with parallel and counter flow arrangement.
4. Understand the design and analysis of shell and tube type heat exchangers.
5. Understand the concept of plate type heat exchanger.

Minimum Six Experiments out of the following:

1. Design of heat exchange equipment by using LMTD method.
2. Design of heat exchange equipment by using effectiveness– NTU method.
3. Design and analysis of double pipe heat exchanger with parallel and counter flow arrangement.
4. Design and analysis of shell and tube type heat exchanger.
5. Design and analysis of plate type heat exchanger.
6. Design of evaporator for refrigeration system.
7. Design of condenser for refrigeration system.

Open Elective Course III

Non-Conventional Energy Resources (OE-ME-701)

L T P C

3 0 0 3

Prerequisite: Basic Knowledge of Power Plant Engineering.

Couse Outcomes (COs):

1. Illustrate the generation of electricity from various Non-Conventional sources of energy, have a working knowledge on types of fuel cells.
2. Study the solar energy, Utilization of it, Principles involved in solar energy collection and conversion of it to electricity generation.
3. Study the working principle of geothermal energy, Magneto-hydrodynamics (MHD) and fuel cell technology for energy generation.
4. Explore the concepts involved in wind energy conversion system by studying its components, types and performance.
5. Study the working principle of bio mass, wave and tidal wave and OTEC.

Course Contents:

Unit I

Introduction: Various non-conventional energy resources- Introduction, availability, classification, relative merits and demerits.

Solar Cells: Theory of solar cells. solar cell materials, solar cell array, solar cell power plant, limitations.

UNIT II

Solar Thermal Energy: Solar radiation, flat plate collectors and their materials, applications and performance, focusing of collectors and their materials, applications and performance; solar thermal power plants, thermal energy storage for solar heating and cooling, limitations.

UNIT III

Geothermal Energy: Resources of geothermal energy, thermodynamics of geo-thermal energy conversion-electrical conversion, non-electrical conversion, environmental considerations.

Magneto-hydrodynamics (MHD): Principle of working of MHD Power plant, performance and limitations.

Fuel Cells: Principle of working of various types of fuel cells and their working, performance and limitations.

UNIT IV

Thermo-electrical and thermionic Conversions: Principle of working, performance and limitations.

Wind Energy: Wind power and its sources, site selection, criterion, momentum theory, classification of rotors, concentrations and augments, wind characteristics. performance and limitations of energy conversion systems.

UNIT V

Bio-mass: Availability of bio-mass and its conversion theory.

Ocean Thermal Energy Conversion (OTEC): Availability, theory and working principle, performance and limitations.

Wave and Tidal Wave: Principle of working, performance and limitations. Waste Recycling Plants.

Text Books:

1. Raja etal, "Introduction to Non-Conventional Energy Resources" Scitech Publications.
2. D.S. Chauhan,"Non-conventional Energy Resources" New Age International.
3. C.S. Solanki, "Renewal Energy Technologies: A Practical Guide for Beginners" PHI Learning.

Reference Books:

1. John Twideu and Tony Weir, "Renewal Energy Resources" BSP Publications, 2006.
2. M.V.R. Koteswara Rao, "Energy Resources: Conventional & Non-Conventional " BSP Publications,2006.

Nanotechnology (OE-ME-702)

L T P C

3 0 0 3

Prerequisite: Basic Knowledge of Materials Science.

Course Outcomes (COs):

After completion of this course student will be able to:

1. Explain the fundamental principles of nanotechnology and their application to engineering.
2. Apply engineering and physics concepts to the Nano-scale and non-continuum domain.
3. Study the properties of individual Nano particles, metal Nano clusters and semi conducting nanomaterial.
4. Discuss and evaluate state-of-the-art characterization methods for nanomaterial, and determine nanomaterial safety and handling methods required during characterization.
5. Explain methods of fabricating nanostructures of carbon Buckey Ball, Carbon nano-tubes

Course Contents:

Unit I

Introduction: Definition of Nano-Science and Nano Technology, Applications of Nano-Technology.

Introduction to Physics of Solid State: Structure: Size dependence of properties; crystal structures, face centered cubic nanoparticles; Tetrehedrally bounded semiconductor structures; lattice vibrations. **Energy Bands:** Insulators, semiconductor and conductors; Reciprocal space; Energy bands and gaps of semiconductors; effective masses; Fermi Surfaces.

Localized Particles: Acceptors and deep taps; mobility; Excitons.

Unit II

Quantum Theory For Nano Science: Time dependent and time independent Schrodinger wave equations. Particle in a box, Potential step: Reflection and tunneling (Quantum leak). Penetration of Barrier, Potential box(Trapped particle in 3D:Nanodot), Electron trapped in 2D plane(Nano sheet), Quantum confinement effect in nano-materials.

Quantum Wells, Wires and Dots: Preparation of Quantum Nanostructure; Size and Dimensionality effect, Fermigas; Potential wells; Partial confinement; Excitons; Single electron Tunneling, Infrared etectors; Quantum dot laser Superconductivity.

Properties of Individual Nano particles, Metal Nano clusters: Magic Numbers; Theoretical Modelling of Nanopraticles; geometric structure; electronic structure; Reactivity; Fluctuations Magnetic Clusters; Bulle to Nano structure.

Semi conducting Nanoparticles: Optical Properties; Photo fragmentation; Coulmbic explosion.

Rare Gas & Molecular Clusters: Inert gas clusters; Superfluid clusters molecular clusters.

Unit III

Growth Techniques of Nanomaterials: Lithograpahic and Nonlithograpahic techniques, Sputtering and film deposition in glow discharge, DC sputtering technique (p-$CuAlO_2$ deposition). Thermal evaporation technique, E-beam evaporation, Chemical Vapour deposition(CVD), Synthesis of carbon nano-fibres and multi-walled carbon nanotubes, Pulsed Laser Deposition, Molecular beam Epitoxy, Sol-Gel Techniuqe (No chemistry required), Synthesis of nanowires/rods, Electrodeposition, Chemical bath deposition, Ion beam deposition system, Vapor-Liquid –Solid (VLS) method of nanowires. **8**

Unit IV

Methods of Measuring Properties: Structure: Crystallography, particle size determination, surface structure,

Microscopy: Scanning Prob Microscopy (SPM), Atomic Force Microscopy (AFM), Field Ion Microscopy, Scanning Electron Microscopy, Transmission Elecrtron Microscopy (TEM)

Spectroscopy: Infrared and Raman Spectroscopy, X-ray Spectroscopy, Magnetic resonance, Optical and Vibrational Spectroscopy, Luninscence.

Unit V

Buckey Ball: Nano structuresof carbon(fullerene): **Carbon nano-tubes:** Fabrication , structure. electrical, mechanical, and vibrational properties and applications. Nano diamond, Boron Nitride Nano-tubes, single elecron transistors, Moelcular machine, Nano-Biometrics, Nano Robots.

Text Books:

1. A.K.Bandyopadhyay, “Nano Materials” New Age International.
2. “Introduction to S.S. Physics” - (7^{th} Edn.) Wiley 1996.

Reference Books:

1. C.P.Poole Jr F.J. Owens, “Introduction to Nanotechnology”. (5).
2. S. Sugano & H. Koizuoni, “Microcluster Physics” –Springor 1998.
3. “Handboole of Nanostructured Materials & Nanotechnology” vol.-5. Academic Press 2000.

Non-Destructive Evaluation (OE-ME-703)

L T P C

3 0 0 3

Prerequisite: Basic Knowledge of Material Science and Engineering.

Course Outcomes (COs):

After completion of this course student will be able to:

1. Obtain the fundamental knowledge about different NDT methods and visual inspection.
2. Explain the principles and testing knowledge of DPT(liquid penetrate inspection) and MPT for product testing.
3. Explain the principles and techniques in Radiography Testing.
4. Describe the knowledge about Ultrasonic Testing for products.
5. Understand the materials and testing procedure for Eddy Current Inspection& Thermography Testing.

Course Contents:

Unit I

Introduction: Scope and advantages of NDT, Comparison of NDT with Destructive Testing, some common NDT methods used since ages, Terminology, Flaws and Defects, Visual inspection, Equipment used for visual inspection. Ringing test, chalk test (oil whitening test). Uses of visual inspection tests in detecting surface defects and their interpretation, advantages & limitations of visual inspection.

Unit II

Tests: Die penetrate test (liquid penetrate inspection), Principle, scope. Equipment & techniques, Test stations, Advantages, types of penetrants and developers, Zyglo test, Illustrative examples and interpretation of defects. Magnetic particle Inspection – scope and working principle, Ferro Magnetic and Non ferromagnetic materials, equipment & testing. Advantages, limitations Interpretation of results, DC& AC magnetization, Skin Effect, use of dye & wet powders for magna glow testing, different methods to generate magnetic fields, Applications.

Unit III

Radiographic methods: Introduction to electromagnetic waves and radioactivity, various decays, Attenuation of electromagnetic radiations, Photo electric effect, Rayleigh's scattering (coherent scattering), Compton's scattering (Incoherent scattering), Pair production, Beam geometry and Scattering factor. X-ray radiography: principle, equipment & methodology, applications, types of radiations and limitations. γ-ray radiography – principle, equipment., source of radioactive materials & technique, advantages of γ-ray radiography over X-ray radiography Precautions against radiation hazards. Case Study - casting and forging.

Unit IV

Ultrasonic testing methods: Introduction, Principle of operation, Piezoelectricity. Ultrasonic probes, CRO techniques, advantages, Limitation & typical applications. Applications in inspection of castings, forgings, Extruded steel parts, bars, pipes, rails and dimensions measurements. Case Study –Ultrasonography of human body.

Unit V

Special NDT Techniques: Eddy Current Inspection: Principle, Methods, Equipment for ECT, Techniques, Sensitivity, advanced ECT methods. Application, scope and limitations, types of Probes and Case Studies. Introduction to Holography, Thermography and Acoustic emission Testing.

Text Books:

1. Non-Destructive Testing and Evaluation of Materials, by- Prasad, McGraw Hill Education
2. Practical Non-destructive Testing, by- Baldev Raj, T. Jayakumar, M. Thavasimuthu, Wood head Publishing.
3. Non-Destructive Testing Techniques, by- Ravi Prakash, New Age International.

Reference Books

1. Nondestructive Testing Handbook,by Robert C. McMaster, American Society for Nondestructive.
2. Introduction to Nondestructive Testing: A Training Guide, by- Paul E. Mix, wiley.
3. Electrical and Magnetic Methods of Non-destructive Testing, by- J. Blitz, springer.
4. Practical non destructive testing by Raj, Baldev.
5. Basics of Non-Destructive Testing, by Lari & Kumar, KATSON Books.

Introduction to Mechanical Micro Machining (OE-ME-704)

L T P C

3 0 0 3

Prerequisite: Basic Knowledge of Conventional machining processes..

Course Outcomes (COs):

1. Understand of process of Ultra Sonic Micro Machining, Abrasive Jet Micro Machining, Water Jet Micro Machining etc.
2. Explain the Beam Energy based micro machining, Electron Beam Micro Machining, Laser Beam Micro Machining, Electric Discharge Micro Machining etc.
3. To understand the Magneto Rheological abrasive flow finishing, Magnetic Float polishing, Elastic Emission Machining etc.
4. Understand of Micro bending with LASER, LASER micro welding, Electron beam for micro welding.
5. Understand the Metrology for micro machined components and Machining of Micro gear, micro nozzle, micro pins, Applications.

Course Contents:

UNIT I

MICRO MACHINING: Ultra Sonic Micro Machining, Abrasive Jet Micro Machining, Water Jet Micro Machining, Abrasive Water Jet Micro Machining, Micro turning, Chemical and Electro Chemical Micro Machining, Electric discharge micro machining.

UNIT II

MICRO MACHINING: Beam Energy based micro machining, Electron Beam Micro Machining, Laser Beam Micro Machining, Electric Discharge Micro Machining, Ion Beam Micro Machining, Plasma Beam Micro Machining, Hybrid Micro machining, Electro Discharge Grinding, Electro Chemical spark micro machining, Electrolytic in process Dressing.

UNIT III

NANO POLISHING: Abrasive Flow finishing, Magnetic Abrasive Finishing, Magneto rheological finishing, Magneto Rheological abrasive flow finishing, Magnetic Float polishing, Elastic Emission Machining, chemo-mechanical Polishing.

UNIT IV

MICRO FORMING AND WELDING: Micro extrusion, Micro and Nano structured surface development by Nano plastic forming and Roller Imprinting, Micro bending with LASER, LASER micro welding, Electron beam for micro welding.

UNIT V

RECENT TRENDS AND APPLICATIONS: Metrology for micro machined components, Ductile regime machining, AE based tool wear compensation, Machining of Micro gear, micro nozzle, micro pins, Applications.

Text Books:

1. Jain V. K., Micro Manufacturing Processes, CRC Press, Taylor & Francis Group, 2012.
2. Jain V.K., ‗Introduction to Micro machining' Narosa Publishing House, 2011
3. Jain V.K., Advanced Machining Processes, Allied Publishers, Delhi, 2002.

Reference Books:

1. Janocha H., Actuators – Basics and applications, Springer publishers – 2012
2. Bharat Bhushan, Handbook of nanotechnology, springer, Germany, 2010.
3. Bandyopadhyay. A.K., Nano Materials, New age international publishers, New Delhi, 2008, ISBN:8122422578.
4. Mcgeoug. J.A., Micromachining of Engineering Materials, CRC press 2001, ISBN-10:0824706447.

Computer Aided Design and Manufacturing (BME-801)

L T P C

3 0 2 4

Prerequisite: Basic Knowledge of Computer.

Course Outcomes (COs):

1. Acquire the knowledge of geometric modelling and Execute the steps required in CAD software for developing 2D and 3D models and perform transformations.
2. Develop mathematical models to represent curves and surfaces.
3. Develop programs for NC and CNC to manufacture industrial components.
4. Illustrate group technology, CAPP and CIM concepts.
5. Understand the concept of FMS and Robotics.

Course Contents:

Unit I

Fundamentals of CAD/CAM, Automation , design process, Application of computers for design, Benefits of CAD, Design workstation, Graphic terminal, CAD software- definition of system software and application software, CAD database and structure. Geometric Transformations, Geometric Modelling: Wireframe model: solid modelling: Boundary Representation (B-rep), Constructive Solid Geometry (CSG), Parametric Modelling Technique ; Mass , volumetric properties calculations; surface modelling, concepts of hidden-line removal and shading: Mechanical Assembly Kinematics analysis and simulation.

Unit II

Representation of curves and surfaces: Non-parametric and parametric representation of curves. Parametric representation of Hermite Cubic, Beizer and B-spline curves; Surface and its analysis. Representation of Analytical and synthetic surfaces.

Overview of FEM, Advantages and applications, recent advance in FEM, FEA software Basic principles and general procedure of FEM.

Unit III

NC Control Production Systems: Numerical control, Elements of NC system, coordinate systems; features of NC machine tools, NC part programming: Methods of NC part programming, manual part programming, Computer assisted part programming, Post Processor, Computerized part program, CNC, DNC and Adaptive Control Systems.

Unit IV

Group Technology (GT): Part families; part classification and coding system: Group technology machine cells, Advantages of GT.

Computer Aided Process Planning: Introduction and benefits of CAPP. Types of CAPP systems, machinability, data selection systems in CAPP.

Computer Integrated Manufacturing Systems: Basic Concepts of CIM: CIM Definition, The meaning of Manufacturing, Types of Manufacturing systems; Need, Elements, Evolution of CIM; Benefits of CIM.

UNIT V

Flexible Manufacturing Systems: Physical Components of an FMS. Types of Flexibility, Layout Considerations; FMS benefits

Robotics: Classification and specification–drive and controls–sensors-end effectors-grippers-tool handling and work handling–machine vision–robot programming concepts–case studies in assembly.

Text Books:

1. Dr. Sadhu Singh - Computer Aided Design and Manufacturing, Khanna Publishers, New Delhi, Second Edition,2000.
2. P. Radha krishnan, - CAD/CAM/CIM, New Age International (P) Ltd., New Delhi.S. Subramanayanand V. Raju.
3. Groover M.P. and - CAD/CAM; Computer Aided Design and Manufacturing, Prentice Hall Zimmers EW. International, New Delhi, 1992.

Reference Books:

1. Chris Mcmahon and - CAD/CAM – Principle Practice and Manufacturing Management, Jimmie Browne Addision Wesley England, Second Edition,2000.
2. Ibrahim Zeid - CAD/CAM theory and Practice, Tata McGraw Hill Publishing Co. Ltd.,Company Ltd., New Delhi, 1992.
3. Mikell P.Groover - Automation , Production Systems and Computer Integrated Manufacturing, Second edition, Prentice Hall of India, 2002.
4. S.Kant Vajpayee - Principles of Computer Integrated Manufacturing, Prentice Hall ofIndia, 1999.
5. David Bed worth - Computer Integrated Design and Manufacturing, TMH, 1998.

Computer Aided Design and Manufacturing (BME-851)

Course Outcomes (COs):

1. Modeling of simple machine parts and assemblies from the part drawings using standard CAD packages.
2. Generate CNC Turning and Milling codes for different operations using standard CAM packages. Write manual part programming using ISO codes for turning and milling operations.

List of Experiments: (Total 8 Experiments are to carried out. 4 Experiments each from CAD and CAM.)

A. CAD Experiments:

1. Line Drawing or Circle Drawing experiment: Writing and validation of computer program.
2. Geometric Transformation algorithm experiment for translation/rotation/scaling: Writing and validation of computer program.
3. Design of machine component or other system experiment: Writing and validation of computer program.
4. Understanding and use of any 3-D Modelling Software commands.
5. Pro/E/Idea etc. Experiment: Solid modelling of a machine component.
6. Writing a small program for FEM for 2 spring system and validation of program or using a FEM Package.

B. CAM Experiments:

1. To study the characteristic features of CNC machine.
2. Part Programming (in word address format) experiment for turning operation (including operations such as grooving and threading) and running on CNC machine.
3. Part Programming (in word address format or ATP) experiment for drilling operation (point to point) and running on CNC machine.
4. Part Programming (in word address format or ATP) experiment for milling operation (contouring) and running on CNC machine.
5. Experiment on difference between ordinary and NC machine, study or retrofitting.
6. Experiment on study of system devices such as motors and feedback devices.
7. Experiment on Mechatronics and controls.

Thermal Turbo Machines (BME-802)

L T P C

3 0 0 3

Prerequisite: Course on Applied Thermodynamics.

Course Outcomes (COs):

After completion of this course student will be able to:

1. Understand the principles of operation of thermal turbo machines.
2. Design different work absorbing turbo machines like compressors and pumps.
3. Design different work producing turbo machines like gas and steam turbines.
4. Understand the functional parameters and components in different turbo machines.

Course Contents:

UNIT I

Introduction of turbo machinery, classification of turbo machines, Review of laws of thermodynamics & SFEE in reference to turbo machinery, Euler's energy transfer equation for turbo machines, Definition of various efficiencies, Preheat factor, Reheat factor, Blade classification, Blade terminology, Cascade testing, Velocity diagrams for axial and radial turbo machinery and pumps.

UNIT II

Centrifugal compressors - Principle of operation, work done and pressure rise, Velocity diagram for centrifugal compressor, Slip factor, Stage pressure rise, Loading coefficient, Diffuser, degree of reaction, Effect of impeller blade profile, Pre-whirl and inlet guide vanes, Centrifugal Compressor characteristic curves.

Axial flow compressor- Principle of operation and working, Energy transfer, Velocity diagram for axial compressor, Factors affecting stage pressure ratio, Blockage in compressor annulus, Degree of reaction, 3-D flow, Design process, blade design, calculation of stage performance, Axial compressor performance characteristic curves.

UNIT III

Axial flow turbines-Elementary theory of axial flow turbine, Energy transfer, Velocity diagram, Types of blades, Vortex theory, Choice of blade profile, pitch and chord, Estimation of stage performance, Characteristic curves.

UNIT IV

Steam turbines: Constructional details, working of steam turbine.

Pumps: Classification of Pumps, Main components, indicator diagram and modification due to piston acceleration, Performance characteristics, Cavitation and its control, miscellaneous types of pumps.

Radial flow turbines: Elementary theory of radial flow turbines, Enthalpy- Entropy diagram, State losses, Estimation of stage performance, Performance characteristics.

UNIT V

Gas Turbine Starting & Control Systems: Starting ignition system, Combustion system types, Safety limits & control.

Turbine Blade cooling: Different cooling techniques, Types of coolants, Comparative evaluation of different cooling techniques.

Text Books:

1. Thermal Turbo machines, Onkar Singh, Wiley India Pvt. Ltd.
2. Gas turbine theory: Cohen & Rogers, Addison Weslay Longman Ltd.
3. Gas Turbine- Ganeshan, Tata Mc Graw Hill.

Reference Books:

1. Design of high efficiency turbo machinery and gas turbines, David Gordon Wilson, Theodosios Korakianitis, Prentice Hall International.
2. Turbo machinery : S.M. Yahya.
3. Turbine, Compressors and Fans, S.M. Yahya, Tata Mc Graw Hill.
4. Turbo machines , D. G. Shepherd.

Departmental Elective IV

Reverse Engineering (DE-ME-801)

L T P C

3 0 0 3

Prerequisite: Basic knowledge of Additive manufacturing.

Course Outcomes (COs):

1. Acquire basic knowledge about the main opportunities provided by Reverse Engineering and Rapid Prototyping tools.
2. Represents an opportunity to learn how to conduct detailed product design by benefitting from cutting-edge technologies.

Course Contents:

UNIT I

Introduction to New Product Development. Tasks of detailed design, new frontiers of Computer-Aided Design tools.

UNIT II

Reverse Engineering: Objectives and common application fields. Existing technologies. Contact systems.

UNIT III

Non-contact systems. Manipulation of acquired data. Practical experiences.

UNIT IV

Introduction to the Basic Principles of Additive Manufacturing. Design for Additive Manufacturing.

UNIT V

Employment of Reverse Engineering and Rapid Prototyping technologies in different industrial fields with an outlook on the South Tyrolean industrial fabric.

Text Books:

1. Eldad Eilam's Reversing: Secrets of reverse engineering.
2. Hacking the Xbox: An Introduction to Reverse Engineering.
3. The IDA Pro Book: The Unofficial Guide to the World's Most Popular Disassembler.

Reference Books:

1. The Art of Memory Forensics: Detecting Malware and Threats in Windows, Linux, and Mac Memory.
2. Practical Malware Analysis: The Hands-On Guide to Dissecting Malicious Software.
3. The Rootkit Arsenal: Escape and Evasion in the Dark Corners of the System 2nd Edition.

Computational Fluid Dynamics (DE-ME-802)

L T P C

3 0 0 3

Prerequisite: Basic knowledge Engineering Fluid Mechanics.

Course Outcomes (COs):

After completion of this course student will be able to:

1. Apply the physical principles to derive the governing equations which govern fluid flow and heat transfer.
2. Solve the diffusion problems using finite difference methods.
3. Solve the diffusion problems using finite volume methods.
4. Understand the various concepts of Finite Volume Method for Convection Diffusion.
5. Apply various algorithms to analyze the flow field and understand the turbulence models for the given problem.

Course Contents:

UNIT I

Governing Equations and Boundary Conditions: Basics of computational fluid dynamics. Governing equations of fluid dynamics. Continuity, Momentum and Energy equations. Chemical species transport. Physical boundary conditions, Time-averaged equations for Turbulent Flow. Turbulent–Kinetic Energy Equations Mathematical behavior of PDEs on CFD. Elliptic, Parabolic and Hyperbolic equations.

UNIT II

Finite Difference Method: Derivation of finite difference equations. Simple Methods. General Methods for first and second order accuracy, solution methods for finite difference equations. Elliptic equations. Iterative solution Methods. Parabolic equations. Explicit and Implicit schemes. Example problems on elliptic and parabolic equations.

UNIT III

Finite Volume Method (FVM) for Diffusion: Finite volume formulation for steady state One, Two- and Three-dimensional diffusion problems. One dimensional unsteady heat conduction through Explicit, Crank. Nicolson and fully implicit schemes.

UNIT IV

Finite Volume Method for Convection Diffusion: Steady one-dimensional convection and diffusion. Central, upwind differencing schemes properties of discretization schemes. Conservativeness, Boundedness, Transportive, Hybrid, Power-law, QUICK Schemes.

UNIT V

Calculation Flow Field by FVM: Representation of the pressure gradient term and continuity equation. Staggered grid. Momentum equations. Pressure and Velocity corrections; Pressure Correction equation, SIMPLE algorithm and its variants. Turbulence models, mixing length model, Two equation (k-Є) models. High and low Reynolds number models.

Text Books:

1. An Introduction to Computational Fluid Dynamics: The Finite Volume Method, by Versteeg, Pearson, India.
2. Numerical Heat Transfer and Fluid Flow, by Patankar, Tayers&Francis.
3. Computational Heat Transfer, by Jaluriaans Torrance, CRC Press.
4. Introduction to Computational Fluid Dynamics, by Prodip Niyogi. Pearson India.

Reference Books:

1. Computational Fluid Dynamics, by Anderson, Mc Graw Hill.
2. Computational Fluid Dynamics, by Chung, Cambridge University Press.
3. Computer Simulation of flow and heat transfer, by Ghoshdastidar McGraw Hill.
4. Computational Fluid Flow and Heat Transfer, by Muralidhar and Sundararajan, Narosa Publishing House.
5. Computational Fluid Dynamics: Principles and Applications, by Blazek, Elsevier Science & Technology.

Open Elective IV

Power Plant Engineering (OE-ME-801)

L T P C

3 1 0 4

Prerequisite: Basic Knowledge of Thermodynamics and I C Engines.

Course outcomes (COs):

1. Understand the basics of power plants.
2. Analyze the working and layout of the of steam power plant.
3. Define the working principles of Diesel power plant, its layout, safety principles and compare it with other types of plants.
4. Discuss the working principle and basic components of the nuclear power plants and Hydro-electric power plants and safety precautions involved with it.
5. Discuss and analyze the mathematical and working principle of different electrical equipment involved in the generation of the power.

Course Contents:

Unit I

Introduction: Power and energy, sources of energy, review of thermodynamic cycles related to power plants, fuels and combustion calculations. Load estimation, load curves, various terms and factors involved in power plant calculations. Effect of variable load on power plant operation, Selection of power plant units. Power plant economics and selection. Effect of plant type on costs, rates, fixed elements, energy elements, customer elements and investor's profit; depreciation and replacement, theory of rates. Economics of plant selection, other considerations in plant selection.

Unit II

Steam power plant: General layout of steam power plant, Power plant boilers including critical and super critical boilers. Fluidized bed boilers, boilers mountings and accessories, Different systems such as coal handling system, pulverizes and coal burners, combustion system, draft, ash handling system, Dust collection system, Feed water treatment and condenser and cooling towers and cooling ponds, Turbine auxiliary systems such as governing, feed heating, reheating, flange heating and gland leakage. Operation and maintenance of steam power plant, heat balance and efficiency, Site selection of a steam power plant.

Unit III

Diesel power plant: General layout, Components of Diesel power plant, Performance of diesel power plant, fuel system, lubrication system, air intake and admission system, supercharging system, exhaust system, diesel plant operation and efficiency, heat balance, Site selection of diesel power plant, Comparative study of diesel power plant with steam power plant. Gas turbine power

plant: Layout of gas turbine power plant, Elements of gas turbine power plants, Gas turbine fuels, cogeneration, auxiliary systems such as fuel, controls and lubrication, operation and maintenance, Combined cycle power plants, Site selection of gas turbine power plant, Integrated Gasifier based Combined Cycle (IGCC) systems.

Unit IV

Nuclear power plant: Layout and subsystems of nuclear power plants, Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANDU Reactor, Pressurized Heavy Water Reactor (PHWR), Fast Breeder Reactors (FBR), gas cooled and liquid metal cooled reactors, safety measures for nuclear power plants. Hydroelectric and Non-Conventional Power Plant: Hydroelectric power plants, classification, typical layout and components, principles of wind, tidal, solar PV and solar thermal, geothermal, biogas and fuel cell power systems.

Unit V

Electrical system: Generators and generator cooling, transformers and their cooling, bus bar, etc. Energy Saving and Control: Energy, economic and environmental issues, power tariffs, load distribution parameters, load curve, capital and operating cost of different power plants, pollution control technologies including waste disposal options for coal and nuclear plants.

Text Books:

1. Power Plant Engineering by P.K. Nag, Tata McGraw Hill.
2. Steam & Gas Turbines & Power Plant Engineering by R. Yadav, Central Pub. House.
3. Power Plant Engineering by Gupta, PHI India.

Reference Books:

1. Power Plant Engineering, by F.T. Morse, Affiliated East-West Press Pvt. Ltd.
2. Power Plant Engineering by Hedge, Pearson India.
3. Power Plant Technology, by Wakil, McGraw Hill.
4. Power Plant Engineering. Mahesh Verma, Metropolitan Book Company Pvt. Ltd.

Optimization Method in Engineering (OE-ME-802)

L T P C

3 1 0 4

Prerequisite: Course on calculus, matrix

Course Outcomes (COs):

After completion of the course a student will be able:

1. Learn one dimensional optimization methods.
2. Learn constrained optimization of multi-variable function.
3. Apply integer programming methods.
4. Dynamic programming and operation research problems
5. Learn soft computing based optimization.

Course Contents:

Unit I

Unconstrained Optimization: Optimizing Single-Variable Functions, Conditions for Local Minimum and Maximum, Optimizing Multi-Variable Functions.

Unit II

Constrained Optimization: Optimizing Multivariable Functions with Equality Constraint: Direct Search Method, Lagrange Multipliers Method, Constrained Multivariable Optimization with inequality constrained: Kuhn-Tucker Necessary conditions, Kuhn –Tucker Sufficient Conditions.

Unit III

Optimization: Quasi-Newton Methods and line search, least squares optimization, Gauss Newton, Extensions of LP to Mixed Integer Linear Programming (MILP), Non-Linar Programming, The Newton Algorithm, Non-Linear Least Squares, Sequential Quadratic Programming (SQP), Constrained Optimization, Multi-Objective Optimization, Branch and Bound Approaches.

Unit IV

Optimization in Operation Research: Dynamic Programming, Minimax and Maximax Algorithm, Discrete Simulation, Integer Programming – Cutting Plane Methods, Separable Programming, Goal Programming, Integer Linear Programming.

Unit V

Soft computing based optimization, Practical aspects of optimization.

Text books:

1. Engineering Optimization Theory and Practice by Rao S.S.
2. Methods of Optimization by Walsh G R.
3. Integer and Combinational Optimization by G.L.Nemhauser and L.A.Wolsey.
4. Operations Research: Applications and Algorithms by Winston W L

Reference books:

1. Model Building in Mathematics Programming by Williams H.P.
2. Integer and Combinational Optimization by G.L.Nemhauser and L.A.Wolsey
3. Discrete Optimization by R.G. Parker and R.L. Rardin.
4. Combinational Optimization: Algorithms and Complexity by C.H. Papadimitrious and K.Stegilite
5. Multi-objective evolutionary optimization for Product Design and Manufacturing by LihuiWang
6. Genetic Algorithms by Kalyanmoy Deb
7. Genetic Algorithms in search, optimization and machine learning by David E Goldberg, Pearson Springer.

Fracture Mechanics (OE-ME-802)

L T P C

3 1 0 4

Prerequisite: Basic Knowledge of Mechanics of Solids and Theory of Elasticity.

Course Outcomes (COs):

1. Basic Understanding of Crack in a Structure, Fracture Toughness, Types of Fracture.
2. Analyze elastic and elastic-plastic stress fields at the crack-tip in a solid material..
3. Estimate crack growth based on energy balance.
4. Demonstrate standard fracture mechanics tests for finding J-Integral and Crack Opening Displacement.
5. Inspect a solid material for the presence of crack.

Course Contents:

Unit I

Introduction: A Crack in a Structure, Fracture Toughness. Micro and Macro Phenomena of Fracture - Microscopic Aspects: Surface Energy, Theoretical Strength, Microstructure and Defects, Crack Formation - Macroscopic Aspects: Crack Growth, Types of Fracture, Mechanisms of Fracture and Crack Growth - Cleavage Fracture, Ductile Fracture, Fatigue Cracking, Environment Assisted Cracking, Creep Fracture, Service Failure Analysis

Unit II

Linear Elastic Stress Fields in Cracked Bodies • Introduction • Crack Deformation Modes and Basic Concepts, Westergaard Method, Singular Stress and Displacement Fields, Stress Intensity Factor Solutions, Three-Dimensional Cracks

Linear Elastic-Plastic Stress Fields in Cracked Bodies: Approximate Determination of the Crack-Tip Plastic Zone, Irwin's Model, Dugdale's Model

Unit III

Crack Growth Based on Energy Balance: Introduction, Energy Balance During Crack Growth, Griffith Theory, Graphical Representation of the Energy Balance Equation, Equivalence between Strain Energy Release Rate and Stress Intensity Factor, Compliance, Crack Stability.

Unit IV

Fracture Criteria: Critical Stress Intensity Factor Fracture Criterion, J-Integral and Crack Opening Displacement Fracture Criteria, Strain Energy Density Failure Criterion: Mixed-Mode Crack Growth.

Dynamic Fracture Introduction, Mott's Model , Stress Field around a Rapidly Propagating Crack , Strain Energy Release Rate, Crack Branching, Crack Arrest ,Experimental Determination of Crack Velocity and Dynamic Stress Intensity

Unit V

Introduction to Fatigue Fracture, Environment-Assisted Fracture, Creep Fracture and Crack Detection Methods such as Dye Penetration, Magnetic Particles, Eddy Current, Radiography, Ultrasonic, and Acoustic Emission**.**

Text Books:

1. Prashant Kumar, "Elements of Fracture Mechanics", Tata McGraw Hill Education Pvt. Ltd.
2. T.L. Anderson, "Fracture Mechanics - Fundamentals and Applications", CRC - Taylor and Francis.

Reference Books:

1. E.E. Gdoutos, "Fracture Mechanics - An Introduction", Springer.
2. D. Broek, "Elementary Engineering Fracture Mechanics", Kluwer Academic Publishers.
3. R.W. Hertzberg, "Deformation and Fracture Mechanics of Engineering Materials", Wiley India Pvt. Ltd.

Machine Tool Design (OE-ME-804)

L T P C

3 1 0 4

Prerequisite: Basic Knowledge of Workshop Technology.

Course Outcomes (COs):

After successful completion of this course students will be able to

1. Understand classification of machine tools with their nomenclature, specification and uses.
2. Explain working of various drives mounted in machine tools.
3. Analyze the speed and feed box with the regulation of speed and feed rates.
4. Design components like structural bed, column, power screws etc.
5. Apply knowledge to study dynamics of machine tool and its control.

Course Contents:

UNIT I

Introduction: Developments is machine tools, types of machine tools surface, profits and paths produced by machine tools. Features of construction and operations of basic machine tools e.g. lathe, drill, milling shapes and planers, grinding machine etc. General requirement of machine tool design. Machine tool design process. Tool wear, force Analysis.

UNIT II

Machine Tools Drives: Classification of machine tool drives, group Vs individual drives, Selection of electric motor, A brief review of the elements of mechanical transmission e.g. gear, belt and chain drives, Slider-crank mechanism, cam mechanism, nut & Screw transmission, Devices for intermittent motion, reversing & differential mechanisms. Couplings and clutches Elements of hydraulic transmission system. e.g. pumps, cylinder, directional control valves, pressure valves etc., Fundamentals of Kinematics structure of machine tools.

UNIT III

Regulation of Speed and Feed rates: Laws of stepped regulation, selection of range ratio, standard progression ratio, selection of best possible structural diagram, speed chart, Design of feed box, developing gearing diagrams. stepless regulation of speed and feed in machine tool, speed and feed control.

UNIT IV

Design of Machine Tool Structure: Requirements and design criteria for machine tool structures, selection of material Basic design procedure for machine tool structures, design of bed, column and housing, Model technique in design.

Design of guide ways and power screws: Basic guide way profiles, designing guide way for stiffness a wear resistance, hydrostatic and antifriction grand ways. Design of sliding friction power

Screws. Design of spindlier & spindle supports. Layout of bearings, selection of bearings for machine tools.

UNIT V

Dynamics of machine tools: General procedure for assessing the dynamic stability of cutting process, closed loop system, chatter in machine tools.

Control Systems: Functions, requirements & types of machine tool controls, controls for speed & feed change. Automatic and manual Controls. Basics of numerical controls. Machine tool testing.

Text Books:

1. N.K. Mehta, "Machine Tool Design and Numerical Control" Second Edition, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1984.
2. S.K. Basu and D.K. Pal, "Design of Machine Tools", Fourth Edition, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 1990.
3. G.C. Sen and A. Bhattacharya, "Principles of Machine Tools", Second Edition, New Central Book Agency (P) Ltd., Kolkata, 1988.

Reference Books:

1. F. Koenigsberger, "Design Principles of Metal Cutting and Machine Tools", Edition 1964, Pergamon Press Ltd., London.
2. H.C. Town, "The Design and Construction of Machine Tools", Central Machine Tool Research Institute, Bangalore, Machine Tool Design Handbook.
3. PSG College of Engg. & Technology, PSG Design Data Book.
4. N.K. Acherkan, "Machine Tool Design (Vol. I to Vol. IV)", Mir Publishers.

CHAPTER –I:REGULATIONS

1. Short Title and Commencement

These regulations shall be called as "The Revised Regulations for the Master of Pharmacy (M. Pharm.)Degree Program – Credit Based Semester System (CBSS) of the Pharmacy Council of India, New Delhi". They shall come into effect from the Academic Year 2016-17. The regulations framed are subject to modifications from time to time by the authorities of the university.

2. Minimum qualification for admission

A Pass in the following examinations

a) B. Pharm Degree examination of an Indian university established by law in India from an institution approved by Pharmacy Council of India and has scored not less than 55% of the maximum marks (aggregate of 4 years of B.Pharm.)

b) Every student, selected for admission to post graduate pharmacy program in any PCI approved institution should have obtained registration with the State Pharmacy Council or should obtain the same within one month from the date of his/her admission, failing which the admission of the candidate shall be cancelled.

Note: It is mandatory to submit a migration certificate obtained from the respective university where the candidate had passed his/her qualifying degree (B.Pharm.)

3. Duration of the program

The program of study for M.Pharm. shall extend over a period of four semesters (two academic years). The curricula and syllabi for the program shall be prescribed from time to time by Phamacy Council of India, New Delhi.

4. Medium of instruction and examinations

Medium of instruction and examination shall be in English.

5. Working days in each semester

Each semestershall consist of not less than 100 working days. The odd semesters shall be conducted from the month of June/July to November/December and the even semesters shall be conducted from the month of December/January to May/June in every calendar year.

6. Attendance and progress

A candidate is required to put in at least 80% attendance in individual courses considering theory and practical separately. The candidate shall complete the prescribed course satisfactorily to be eligible to appear for the respective examinations.

7. Program/Course credit structure

As per the philosophy of Credit Based Semester System, certain quantum of academic work viz. theory classes, practical classes, seminars, assignments, etc. are measured in terms of credits. On satisfactory completion of the courses, a candidate earns credits. The amount of credit associated with a course is dependent upon the number of hours of instruction per week in that course. Similarly the credit associated with any of the other academic, co/extra-curricular activities is dependent upon the quantum of work expected to be put in for each of these activities per week/per activity.

7.1. Credit assignment

7.1.1. Theory and Laboratory courses

Courses are broadly classified as Theory and Practical. Theory courses consist of lecture (L) and Practical (P) courses consist of hours spent in the laboratory. Credits (C) for a course is dependent on the number of hours of instruction per week in that course, and is obtained by using a multiplier of one (1) for lecture and a multiplier of half (1/2) for practical (laboratory) hours.Thus, for example, a theory course having four lectures per week throughout the semester carries a credit of 4. Similarly, a practical having four laboratory hours per week throughout semester carries a credit of 2.
The contact hours of seminars, assignments and research work shall be treated as that of practical courses for the purpose of calculating credits. i.e., the contact hours shall be multiplied by 1/2. Similarly, the contact hours of journal club, research work presentations and discussions with the supervisor shall be considered as theory course and multiplied by 1.

7.2. Minimum credit requirements

The minimum credit points required for the award of M. Pharm. degree is 95. However based on the credit points earned by the students under the head of co-curricular activities, a student shall earn a maximum of 100 credit points. These credits are divided into Theory courses, Practical, Seminars, Assignments, Research work, Discussions with the supervisor, Journal club and Co-Curricular activities over the duration of four semesters. The credits

are distributed semester-wise as shown in Table 5. Courses generally progress in sequence, building competencies and their positioning indicates certain academic maturity on the part of the learners. Learners are expected to follow the semester-wise schedule of courses given in the syllabus.

8. Academic work

A regular record of attendance both in Theory, Practical, Seminar, Assignment, Journal club, Discussion with the supervisor, Research work presentation and Dissertation shall be maintained by the department / teaching staff of respective courses.

9. Course of study

The specializations in M.Pharm program is given in Table 1.

Table – 1: List of M.Pharm. Specializations and their Code

S. No.	Specialization	Code
1.	Pharmaceutics	MPH
2.	Pharmaceutical Chemistry	MPC
3.	Pharmaceutical Regulatory Affairs	MRA
4.	Pharmacology	MPL
5.	Pharmacognosy	MPG

The course of study for M.Pharm specializations shall include Semester wise Theory & Practical as given in Table – 2. The number of hours to be devoted to each theory and practical course in any semester shall not be less than that shown in Table – 2.

Table – 2: Course of study for M. Pharm. (Pharmaceutics)

Course Code	Course	Credit Hours	Credit Points	Hrs./wk	Marks
Semester I					
MPH101T	Modern Pharmaceutical Analytical Techniques	4	4	4	100
MPH102T	Drug Delivery System	4	4	4	100
MPH103T	Modern Pharmaceutics	4	4	4	100
MPH104T	Regulatory Affair	4	4	4	100
MPH105P	Pharmaceutics Practical I	12	6	12	150
-	Seminar/Assignment	7	4	7	100
Total		35	26	35	650
Semester II					
MPH201T	Molecular Pharmaceutics (Nano Tech and Targeted DDS)	4	4	4	100
MPH202T	Advanced Biopharmaceutics & Pharmacokinetics	4	4	4	100
MPH203T	Computer Aided Drug Delivery System	4	4	4	100
MPH204T	Cosmetic and Cosmeceuticals	4	4	4	100
MPH205P	Pharmaceutics Practical II	12	6	12	150
-	Seminar/Assignment	7	4	7	100
	Total	35	26	35	650

Table – 3: Course of study for M. Pharm. III Semester
(Common for All Specializations)

Course Code	Course	Credit Hours	Credit Points
MRM 301T	Research Methodology and Biostatistics*	4	4
-	Journal club	1	1
-	Discussion / Presentation (Proposal Presentation)	2	2
-	Research Work	28	14
Total		35	21

* Non University Exam

Table – 4: Course of study for M. Pharm. IV Semester
(Common for All Specializations)

Course Code	Course	Credit Hours	Credit Points
-	Journal Club	1	1
-	Research Work	31	16
-	Discussion/Final Presentation	3	3
Total		35	20

Table – 5: Semester wise credits distribution

Semester	Credit Points
I	26
II	26
III	21
IV	20
Co-curricular Activities (Attending Conference, Scientific Presentations and Other Scholarly Activities)	Minimum=02 Maximum=07*
Total Credit Points	Minimum=95 Maximum=100*

*Credit Points for Co-curricular Activities

Table – 6: Guidelines for Awarding Credit Points for Co-curricular Activities

Name of the Activity	Maximum Credit Points Eligible / Activity
Participation in National Level Seminar/Conference/Workshop/Symposium/ Training Programs (related to the specialization of the student)	01
Participation in international Level Seminar/Conference/Workshop/Symposium/ Training Programs (related to the specialization of the student)	02
Academic Award/Research Award from State Level/National Agencies	01
Academic Award/Research Award from International Agencies	02
Research / Review Publication in National Journals (Indexed in Scopus / Web of Science)	01
Research / Review Publication in International Journals (Indexed in Scopus / Web of Science)	02

Note: International Conference: Held Outside India

International Journal: The Editorial Board Outside India

*The credit points assigned for extracurricular and or co-curricular activities shall be given by the Principals of the colleges and the same shall be submitted to the University. The criteria to acquire this credit point shall be defined by the colleges from time to time.

10. Program Committee

1. The M. Pharm. programme shall have a Programme Committee constituted by the Head of the institution in consultation with all the Heads of the departments.

2. The composition of the Programme Committee shall be as follows:

A teacher at the cadre of Professor shall be the Chairperson; One Teacher from eachM.Pharm specialization and four student representatives (two from each academic year), nominated by the Head of the institution.

3. Duties of the Programme Committee:

i. Periodically reviewing the progress of the classes.
ii. Discussing the problems concerning curriculum, syllabus and the conduct of classes.
iii. Discussing with the course teachers on the nature and scope of assessment for the course and the same shall be announced to the students at the beginning of respective semesters.

iv. Communicating its recommendation to the Head of the institution on academic matters.
v. The Programme Committee shall meet at least twice in a semester preferably at the end of each sessionalexam and before the end semester exam.

11. Examinations/Assessments

The schemes for internal assessment and end semester examinations are given in Table – 7.

11.1. End semester examinations

The End Semester Examinations for each theory and practical coursethrough semesters I to IVshall beconducted by the respective university except for the subject with asterix symbol (*) in table I and II for which examinations shall be conducted by the subject experts at college level and the marks/grades shall be submitted to the university.

Tables – 7 : Schemes for internal assessments and end semester

(Pharmaceutics- MPH)

Course Code	Course	Internal Assessment				End Semester Exams		Total Marks
		Continuous Mode	Sessional Exams		Total	Marks	Duration	
			Marks	Duration				
SEMESTER I								
MPH 101T	Modern Pharmaceutical Analytical Techniques	10	15	1 Hr	25	75	3 Hrs	100
MPH 102T	Drug Delivery System	10	15	1 Hr	25	75	3 Hrs	100
MPH 103T	Modern Pharmaceutics	10	15	1 Hr	25	75	3 Hrs	100
MPH 104T	Regulatory Affair	10	15	1 Hr	25	75	3 Hrs	100
MPH 105P	Pharmaceutics PracticalI	20	30	6 Hrs	50	100	6 Hrs	150
-	Seminar /Assignment	-	-	-	-	-	-	100
Total								650
SEMESTER II								
MPH 201T	Molecular Pharmaceutics(Nano Tech and Targeted DDS)	10	15	1 Hr	25	75	3 Hrs	100
MPH 202T	Advanced Biopharmaceutics & Pharmacokinetics	10	15	1 Hr	25	75	3 Hrs	100
MPH 203T	Computer Aided Drug Delivery System	10	15	1 Hr	25	75	3 Hrs	100
MPH 204T	Cosmetic and Cosmeceuticals	10	15	1 Hr	25	75	3 Hrs	100
MPH 205P	Pharmaceutics Practical I	20	30	6 Hrs	50	100	6 Hrs	150
-	Seminar /Assignment	–	–	–	–	–	–	100
Total								650

Tables – 8: Schemes for internal assessments and end semester examinations (Semester III& IV)

Course Code	Course	Internal Assessment				End Semester Exams		Total Marks
		Continuous Mode	Sessional Exams		Total	Marks	Duration	
			Marks	Duration				
SEMESTER III								
MRM301T	Research Methodology and Biostatistics*	10	15	1 Hr	25	75	3 Hrs	100
-	Journal club	-	-	-	25	-	-	25
-	Discussion / Presentation (Proposal Presentation)	-	-	-	50	-	-	50
-	Research work*	-	-	-	-	350	1 Hr	350
Total								525
SEMESTER IV								
-	Journal club	-	-	-	25	-	-	25
-	Discussion / Presentation (Proposal Presentation)	-	-	-	75	-	-	75
-	Research work and Colloquium	-	-	-	-	400	1 Hr	400
Total								500

*Non University Examination

11.2. Internal assessment: Continuous mode

The marks allocated for Continuous mode of Internal Assessment shall be awarded as per the scheme given below.

Table – 9: Scheme for awarding internal assessment: Continuous mode

Theory	
Criteria	Maximum Marks
Attendance (Refer Table – 28)	8
Student – Teacher interaction	2
Total	10
Practical	
Attendance (Refer Table – 28	10
Based on Practical Records, Regular viva voce, etc.	10
Total	20

Table – 10: Guidelines for the allotment of marks for attendance

Percentage of Attendance	Theory	Practical
95 – 100	8	10
90 – 94	6	7.5
85 – 89	4	5
80 – 84	2	2.5
Less than 80	0	0

11.2.1. Sessional Exams

Two sessional exams shall be conducted for each theory / practical course as per the schedule fixed by the college(s). The scheme of question paper for theory and practical sessional examinations is given in the table. The average marks of two sessional exams shall be computed for internal assessment as per the requirements given in tables.

12. Promotion and award of grades

A student shall be declared PASS and eligible for getting grade in a course of M.Pharm.programme if he/she secures at least 50% marks in that particular courseincluding internal assessment.

13. Carry forward of marks

In case a student fails to secure the minimum 50% in any Theory or Practical course as specified in 8, then he/she shall reappear for the end semester examination of that course. However his/her marks of the Internal Assessment shall be carried over and he/she shall be entitled for grade obtained by him/her on passing.

14. Improvement of internal assessment

A student shall have the opportunity to improve his/her performance only once in the sessional exam component of the internal assessment. The re-conduct of the sessional exam shall be completed before the commencement of next end semester theory examinations.

15. Reexamination of end semester examinations

Reexamination of end semester examination shall be conducted as per the schedule given in table 11. The exact dates of examinations shall be notified from time to time.

Table – 11: Tentative schedule of end semester examinations

Semester	For Regular Candidates	For Failed Candidates
I and III	November / December	May / June
II and IV	May / June	November / December

16. Allowed to keep terms (ATKT):

No student shall be admitted to any examination unless he/she fulfills the norms given in 6. ATKT rules are applicable as follows:

A student shall be eligible to carry forward all the courses of I and IIsemesters till the III semester examinations. However, he/she shall not be eligible to attend the courses of IV semester until all the courses of I, II and III semesters are successfully completed.

A student shall be eligible to get his/her CGPA upon successful completion of the courses of I to IV semesters within the stipulated time period as per the norms.

Note: Grade AB should be considered as failed and treated as one head for deciding ATKT. Such rules are also applicable for those students who fail to register for examination(s) of any course in any semester.

17. Grading of performances

17.1. Letter grades and grade points allocations:

Based on the performances, each student shall be awarded a final letter grade at the end of the semester for each course.The letter grades and their corresponding grade points are given in Table – 12.

Table – 12: Letter grades and grade points equivalent to Percentage of marks and performances

Percentage of Marks Obtained	Letter Grade	Grade Point	Performance
90.00 – 100	O	10	Outstanding
80.00 – 89.99	A	9	Excellent
70.00 – 79.99	B	8	Good
60.00 – 69.99	C	7	Fair
50.00 – 59.99	D	6	Average
Less than 50	F	0	Fail
Absent	AB	0	Fail

A learner who remains absent for any end semester examination shall be assigned a letter grade of AB and a corresponding grade point of zero. He/she should reappear for the said evaluation/examination in due course.

18. The Semester grade point average (SGPA)

The performance of a student in a semester is indicated by a number called 'Semester Grade Point Average' (SGPA). The SGPA is the weighted average of the grade points obtainedin all the courses by the student during the semester. For example, if a student takes five courses (Theory/Practical) in a semester with credits C1, C2, C3 and C4 and the student's grade points in these courses are G1, G2, G3 and G4, respectively, and then students' SGPA is equal to:

$$SGPA = \frac{C_1G_1 + C_2G_2 + C_3G_3 + C_4G_4}{C_1 + C_2 + C_3 + C_4}$$

The SGPA is calculated to two decimal points. It should be noted that, the SGPA for any semester shall take into consideration the F and ABS grade awarded in that semester. For example if a learner has a F or ABS grade in course 4, theSGPA shall then be computed as:

$$SGPA = \frac{C_1G_1 + C_2G_2 + C_3G_3 + C_4 * ZERO}{C_1 + C_2 + C_3 + C_4}$$

19. Cumulative Grade Point Average (CGPA)

The CGPA is calculated with the SGPA of all the IV semesters to two decimal points and is indicated in final grade report card/final transcript showing the grades of all IV semesters and their courses. The CGPA shall reflect the failed statusin case of F grade(s), tillthe course(s) is/are passed. When the course(s) is/are passedby obtaining a pass grade on subsequent examination(s) theCGPA

shall only reflect the new grade and not the fail grades earned earlier. The CGPA is calculated as:

$$CGPA = \frac{C_1S_1 + C_2S_2 + C_3S_3 + C_4S_4}{C_1 + C_2 + C_3 + C_4}$$

where C_1, C_2, C_3,.... is the total number of credits for semester I,II,III,.... and S_1,S_2, S_3,....is the SGPA of semester I,II,III,.... .

20. Declaration of class

The class shall be awarded on the basis of CGPA as follows:

First Class with Distinction	= CGPA of. 7.50 and above
First Class	= CGPA of 6.00 to 7.49
Second Class	= CGPA of 5.00 to 5.99

21. Project work

All the students shall undertake a project under the supervision of a teacher in Semester III to IV and submit a report. 4 copies of the project report shall be submitted (typed & bound copy not less than 75 pages).

The internal and external examiner appointed by the University shall evaluate the project at the time of the Practical examinations of other semester(s). The projects shall be evaluated as per the criteria given below.

Evaluation of Dissertation Book:

Objective(s) of the work done	50 Marks
Methodology adopted	150 Marks
Results and Discussions	250 Marks
Conclusions and Outcomes	50 Marks
Total	500 Marks

Evaluation of Presentation:

Presentation of work	100 Marks
Communication skills	50 Marks
Question and answer skills	100 Marks
Total	250 Marks

22. Award of Ranks

Ranks and Medals shall be awarded on the basis of final CGPA. However, candidates who fail in one or more courses during the M.Pharm program shall not be eligible for award of ranks. Moreover, the candidates should have completed the M. Pharm program in minimum prescribed number of years, (two years) for the award of Ranks.

23. Award of degree

Candidates who fulfill the requirements mentioned above shall be eligible for award of degree during the ensuing convocation.

24. Duration for completion of the program of study

The duration for the completion of the program shall be fixed as double the actual duration of the program and the students have to pass within the said period, otherwise they have to get fresh Registration.

25. Revaluation I Retotaling of answer papers

There is no provision for revaluation of the answer papers in any examination. However, the candidates can apply for retotaling by paying prescribed fee.

26. Re-admission after break of study

Candidate who seeks re-admission to the program after break of study has to get the approval from the university by paying a condonation fee.

PHARMACEUTICS(MPH)

MODERN PHARMACEUTICAL ANALYTICAL TECHNIQUES
(MPH 101T)

Scope

This subject deals with various advanced analytical instrumental techniques for identification, characterization and quantification of drugs. Instruments dealt are NMR, Mass spectrometer, IR, HPLC, GC etc.

Objectives

After completion of course student is able to know,

- Chemicals and Excipients
- The analysis of various drugs in single and combination dosage forms
- Theoretical and practical skills of the instruments

THEORY 60 HOURS

1. a. UV-Visible spectroscopy: Introduction, Theory, Laws, Instrumentation associated with UV-Visible spectroscopy, Choice of solvents and solvent effect and Applications of UV-Visible spectroscopy. — 11 Hrs

   b. IR spectroscopy: Theory, Modes of Molecular vibrations, Sample handling, Instrumentation of Dispersive and Fourier – Transform IR Spectrometer, Factors affecting vibrational frequencies and Applications of IR spectroscopy

   c. Spectroflourimetry: Theory of Fluorescence, Factors affecting fluorescence, Quenchers, Instrumentation and Applications of fluorescence spectrophotometer.

   d. Flame emission spectroscopy and Atomic absorption spectroscopy: Principle, Instrumentation, Interferences and Applications.

2 NMR spectroscopy: Quantum numbers and their role in NMR, Principle, Instrumentation, Solvent requirement in NMR, Relaxation process, NMR signals in various compounds, Chemical shift, Factors influencing chemical shift, Spin-Spin coupling, Coupling constant, Nuclear magnetic double resonance, Brief outline of principles of FT-NMR and 13C NMR. Applications of NMR spectroscopy. — 11 Hrs

3	Mass Spectroscopy: Principle, Theory, Instrumentation of Mass Spectroscopy, Different types of ionization like electron impact, chemical, field, FAB and MALDI, APCI, ESI, APPI Analyzers of Quadrupole and Time of Flight, Mass fragmentation and its rules, Meta stable ions, Isotopic peaks and Applications of Mass spectroscopy	11 Hrs
4	Chromatography: Principle, apparatus, instrumentation, chromatographic parameters, factors affecting resolution and applications of the following: a) Paper chromatography b) Thin Layer chromatography c) Ion exchange chromatography d) Column chromatography e) Gas chromatography f) High Performance Liquid chromatography g) Affinity chromatography	11 Hrs
5	a. Electrophoresis: Principle, Instrumentation, Working conditions, factors affecting separation and applications of the following: a) Paper electrophoresis b) Gel electrophoresis c) Capillary electrophoresis d) Zone electrophoresis e) Moving boundary electrophoresis f) Iso electric focusing b. X ray Crystallography: Production of X rays, Different X ray diffraction methods, Bragg's law, Rotating crystal technique, X ray powder technique, Types of crystals and applications of X-ray diffraction.	11 Hrs
6	Immunological assays : RIA (Radio immuno assay), ELISA, Bioluminescence assays.	5 Hrs

REFERENCES

1. Spectrometric Identification of Organic compounds – Robert M Silverstein, Sixth edition, John Wiley & Sons, 2004.
2. Principles of Instrumental Analysis – Doglas A Skoog, F. James Holler, Timothy A. Nieman, 5th edition, Eastern press, Bangalore, 1998.
3. Instrumental methods of analysis – Willards, 7th edition, CBS publishers.
4. Practical Pharmaceutical Chemistry – Beckett and Stenlake, Vol II, 4th edition, CBS Publishers, New Delhi, 1997.
5. Organic Spectroscopy – William Kemp, 3rd edition, ELBS, 1991.
6. Quantitative Analysis of Drugs in Pharmaceutical formulation – P D Sethi, 3rd Edition, CBS Publishers, New Delhi, 1997.
7. Pharmaceutical Analysis– Modern methods – Part B – J W Munson, Volume 11, Marcel Dekker Series

DRUG DELIVERY SYSTEMS
(MPH 102T)

SCOPE

This course is designed to impart knowledge on the area of advances in novel drug delivery systems.

OBJECTIVES

Upon completion of the course, student shall be able to understand

- The various approaches for development of novel drug delivery systems.
- The criteria for selection of drugs and polymers for the development of delivering system
- The formulation and evaluation of Novel drug delivery systems..

THEORY 60 Hrs

1.	Sustained Release(SR) and Controlled Release (CR) formulations: Introduction & basic concepts, advantages/ disadvantages, factors influencing, Physicochemical & biological approaches for SR/CR formulation, Mechanism of Drug Delivery from SR/CR formulation. Polymers: introduction, definition, classification, properties and application Dosage Forms for Personalized Medicine: Introduction, Definition, Pharmacogenetics, Categories of Patients for Personalized Medicines: Customized drug delivery systems, Bioelectronic Medicines, 3D printing of pharmaceuticals, Telepharmacy.	10 Hrs
2	Rate Controlled Drug Delivery Systems: Principles & Fundamentals, Types, Activation; Modulated Drug Delivery Systems;Mechanically activated, pH activated, Enzyme activated, and Osmotic activated Drug Delivery Systems Feedback regulated Drug Delivery Systems; Principles & Fundamentals.	10 Hrs
3	Gastro-Retentive Drug Delivery Systems: Principle, concepts advantages and disadvantages, Modulation of GI transit time approaches to extend GI transit. Buccal Drug Delivery Systems: Principle of muco adhesion, advantages and disadvantages, Mechanism of drug permeation, Methods of formulation and its evaluations.	10 Hrs
4	Occular Drug Delivery Systems: Barriers of drug permeation, Methods to overcome barriers.	06 Hrs

5	Transdermal Drug Delivery Systems: Structure of skin and barriers, Penetration enhancers, Transdermal Drug Delivery Systems, Formulation and evaluation.	10 Hrs
6	Protein and Peptide Delivery: Barriers for protein delivery. Formulation and Evaluation of delivery systems of proteins and other macromolecules.	08 Hrs
7	Vaccine delivery systems: Vaccines, uptake of antigens, single shot vaccines, mucosal and transdermal delivery of vaccines.	06 Hrs

REFERENCES

1. Y W. Chien, Novel Drug Delivery Systems, 2nd edition, revised and expanded, Marcel Dekker, Inc., New York, 1992.
2. Robinson, J. R., Lee V. H. L, Controlled Drug Delivery Systems, Marcel Dekker,Inc., New York, 1992.
3. Encyclopedia of controlled delivery, Editor- Edith Mathiowitz, Published by WileyInterscience Publication, John Wiley and Sons, Inc, New York! Chichester/Weinheim
4. N.K. Jain, Controlled and Novel Drug Delivery, CBS Publishers & Distributors, New Delhi, First edition 1997 (reprint in 2001).
5. S.P.Vyas and R.K.Khar, Controlled Drug Delivery – concepts and advances, Vallabh Prakashan, New Delhi, First edition 2002

JOURNALS

1. Indian Journal of Pharmaceutical Sciences (IPA)
2. Indian drugs (IDMA)
3. Journal of controlled release (Elsevier Sciences) desirable
4. Drug Development and Industrial Pharmacy (Marcel & Decker) desirable

MODERN PHARMACEUTICS
(MPH 103T)

Scope

Course designed to impart advanced knowledge and skills required to learn various aspects and concepts at pharmaceutical industries

Objectives

Upon completion of the course, student shall be able to understand

- The elements of preformulation studies.
- The Active Pharmaceutical Ingredients and Generic drug Product development
- Industrial Management and GMP Considerations.
- Optimization Techniques & Pilot Plant Scale Up Techniques
- Stability Testing, sterilization process & packaging of dosage forms.

THEORY 60 HRS

1.	a. Preformation Concepts – Drug Excipient interactions – different methods, kinetics of stability, Stability testing. Theories of dispersion and pharmaceutical Dispersion (Emulsion and Suspension, SMEDDS) preparation and stability Large and small volume parental – physiological and formulation consideration, Manufacturing and evaluation.	10 Hrs
	b. Optimization techniques in Pharmaceutical Formulation: Concept and parameters of optimization, Optimization techniques in pharmaceutical formulation and processing. Statistical design, Response surface method, Contour designs, Factorial designs and application in formulation	10 Hrs
2	Validation : Introduction to Pharmaceutical Validation, Scope & merits of Validation, Validation and calibration of Master plan, ICH & WHO guidelines for calibration and validation of equipments, Validation of specific dosage form, Types of validation. Government regulation, Manufacturing Process Model, URS, DQ, IQ, OQ & P.Q. of facilities.	10 Hrs
3	cGMP & Industrial Management: Objectives and policies of current good manufacturing practices, layout of buildings, services, equipments and their maintenance Production management: Production organization, , materials management, handling and transportation, inventory management and control, production and planning control, Sales forecasting, budget and cost control, industrial and personal relationship. Concept of Total Quality Management.	10 Hrs

4	Compression and compaction: Physics of tablet compression, compression, consolidation, effect of friction, distribution of forces, compaction profiles. Solubility.	10 Hrs
5	Study of consolidation parameters; Diffusion parameters, Dissolution parameters and Pharmacokinetic parameters, Heckel plots, Similarity factors – f2 and f1, Higuchi and Peppas plot, Linearity Concept of significance, Standard deviation , Chi square test, students T-test , ANOVA test.	10 Hrs

REFERENCES

1. Theory and Practice of Industrial Pharmacy By Lachmann and Libermann
2. Pharmaceutical dosage forms: Tablets Vol. 1-3 by Leon Lachmann.
3. Pharmaceutical Dosage forms: Disperse systems, Vol, 1-2; By Leon Lachmann.
4. Pharmaceutical Dosage forms: Parenteral medications Vol. 1-2; By Leon Lachmann.
5. Modern Pharmaceutics; By Gillbert and S. Banker.
6. Remington's Pharmaceutical Sciences.
7. Advances in Pharmaceutical Sciences Vol. 1-5; By H.S. Bean & A.H. Beckett.
8. Physical Pharmacy; By Alfred martin
9. Bentley's Textbook of Pharmaceutics – by Rawlins.
10. Good manufacturing practices for Pharmaceuticals: A plan for total quality control, Second edition; By Sidney H. Willig.
11. Quality Assurance Guide; By Organization of Pharmaceutical producers of India.
12. Drug formulation manual; By D.P.S. Kohli and D.H.Shah. Eastern publishers, New Delhi.
13. How to practice GMPs; By P.P.Sharma. Vandhana Publications, Agra.
14. Pharmaceutical Process Validation; By Fra. R. Berry and Robert A. Nash.
15. Pharmaceutical Preformulations; By J.J. Wells.
16. Applied production and operations management; By Evans, Anderson, Sweeney and Williams.
17. Encyclopaedia of Pharmaceutical technology, Vol I – III.

REGULATORY AFFAIRS

(MPH 104T)

Scope

Course designed to impart advanced knowledge and skills required to learn the concept of generic drug and their development, various regulatory filings in different countries, different phases of clinical trials and submitting regulatory documents : filing process of IND, NDA and ANDA

- To know the approval process of
- To know the chemistry, manufacturing controls and their regulatory importance
- To learn the documentation requirements for
- To learn the importance and

Objectives:

Upon completion of the course, it is expected that the students will be able to understand

- The Concepts of innovator and generic drugs, drug development process
- The Regulatory guidance's and guidelines for filing and approval process
- Preparation of Dossiers and their submission to regulatory agencies in different countries
- Post approval regulatory requirements for actives and drug products
- Submission of global documents in CTD / eCTD formats
- Clinical trials requirements for approvals for conducting clinical trials
- Pharmacovigilence and process of monitoring in clinical trials.

THEORY 60 Hrs

1. a. Documentation in Pharmaceutical industry: Master formula record, DMF (Drug Master File), distribution records. Generic drugs product development Introduction , Hatch-Waxman act and amendments, CFR (CODE OF FEDERAL REGULATION) ,drug product performance, in-vitro, ANDA regulatory approval process, NDA approval process, BE and drug product assessment, in -vivo, scale up process approval changes, post marketing surveillance, outsourcing BA and BE to CRO. 12 Hrs

   b. Regulatory requirement for product approval: API, biologics, novel, therapies obtaining NDA, ANDA for generic drugs ways and means of US registration for foreign drugs

2	CMC, post approval regulatory affairs. Regulation for combination products and medical devices.CTD and ECTD format, industry and FDA liaison. ICH – Guidelines of ICH-Q, S E, M. Regulatory requirements of EU, MHRA, TGA and ROW countries.	12 Hrs
3	Non clinical drug development: Global submission of IND, NDA, ANDA. Investigation of medicinal products dossier, dossier (IMPD) and investigator brochure (IB).	12 Hrs
4	Clinical trials: Developing clinical trial protocols. Institutional review board/ independent ethics committee Formulation and working procedures informed Consent process and procedures. HIPAA- new, requirement to clinical study process, pharmacovigilance safety monitoring in clinical trials.	12 Hrs

REFERENCES

1. Generic Drug Product Development, Solid Oral Dosage forms, Leon Shargel and IsaderKaufer,Marcel Dekker series, Vol.143
2. The Pharmaceutical Regulatory Process, Second Edition Edited by Ira R. Berry and Robert P.Martin, Drugs and the Pharmaceutical Sciences,Vol.185, Informa Health care Publishers.
3. New Drug Approval Process: Accelerating Global Registrations By Richard A Guarino, MD,5th edition, Drugs and the Pharmaceutical Sciences,Vol.190.
4. Guidebook for drug regulatory submissions / Sandy Weinberg. By John Wiley & Sons.Inc.
5. FDA regulatory affairs: a guide for prescription drugs, medical devices, and biologics/edited By Douglas J. Pisano, David Mantus.
6. Clinical Trials and Human Research: A Practical Guide to Regulatory Compliance By Fay A.Rozovsky and Rodney K. Adams
7. www.ich.org/
8. www.fda.gov/
9. europa.eu/index_en.htm
10. https://www.tga.gov.au/tga-basics

PHARMACEUTICS PRACTICALS - I
(MPH 105P)

1. Analysis of pharmacopoeial compounds and their formulations by UV Vis spectrophotometer
2. Simultaneous estimation of multi component containing formulations by UV spectrophotometry
3. Experiments based on HPLC
4. Experiments based on Gas Chromatography
5. Estimation of riboflavin/quinine sulphate by fluorimetry
6. Estimation of sodium/potassium by flame photometry
7. To perform In-vitro dissolution profile of CR/ SR marketed formulation
8. Formulation and evaluation of sustained release matrix tablets
9. Formulation and evaluation osmotically controlled DDS
10. Preparation and evaluation of Floating DDS- hydro dynamically balanced DDS
11. Formulation and evaluation of Muco adhesive tablets.
12. Formulation and evaluation of trans dermal patches.
13. To carry out preformulation studies of tablets.
14. To study the effect of compressional force on tablets disintegration time.
15. To study Micromeritic properties of powders and granulation.
16. To study the effect of particle size on dissolution of a tablet.
17. To study the effect of binders on dissolution of a tablet.
18. To plot Heckal plot, Higuchi and peppas plot and determine similarity factors.

MOLECULAR PHARMACEUTICS (NANO TECHNOLOGY & TARGETED DDS) (NTDS)

(MPH 201T)

Scope

This course is designed to impart knowledge on the area of advances in novel drug delivery systems.

Objectives

Upon completion of the course student shall be able to understand

- The various approaches for development of novel drug delivery systems.
- The criteria for selection of drugs and polymers for the development of NTDS
- The formulation and evaluation of novel drug delivery systems.

THEORY — 60 Hrs

1.	Targeted Drug Delivery Systems: Concepts, Events and biological process involved in drug targeting. Tumor targeting and Brain specific delivery.	12 Hrs
2	Targeting Methods: introduction preparation and evaluation. Nano Particles & Liposomes: Types, preparation and evaluation.	12 Hrs
3	Micro Capsules / Micro Spheres: Types, preparation and evaluation , Monoclonal Antibodies ; preparation and application, preparation and application of Niosomes, Aquasomes, Phytosomes, Electrosomes.	12 Hrs
4	Pulmonary Drug Delivery Systems : Aerosols, propellents, ContainersTypes, preparation and evaluation, Intra Nasal Route Delivery systems; Types, preparation and evaluation.	12 Hrs
5	Nucleic acid based therapeutic delivery system : Gene therapy, introduction (ex-vivo & in-vivo gene therapy). Potential target diseases for gene therapy (inherited disorder and cancer). Gene expression systems (viral and nonviral gene transfer). Liposomal gene delivery systems. Biodistribution and Pharmacokinetics. knowledge of therapeutic antisense molecules and aptamers as drugs of future.	12 Hrs

REFERENCES

1. Y W. Chien, Novel Drug Delivery Systems, 2nd edition, revised and expanded,Marcel Dekker, Inc., New York, 1992.
2. S.P.Vyas and R.K.Khar, Controlled Drug Delivery – concepts and advances, VallabhPrakashan, New Delhi, First edition 2002.
3. N.K. Jain, Controlled and Novel Drug Delivery, CBS Publishers & Distributors, NewDelhi, First edition 1997 (reprint in 2001).

ADVANCED BIOPHARMACEUTICS & PHARMACOKINETICS
(MPH 202T)

Scope

This course is designed to impart knowledge and skills necessary for dose calculations, dose adjustments and to apply biopharmaceutics theories in practical problem solving. Basic theoretical discussions of the principles of biopharmaceutics and pharmacokinetics are provided to help the students' to clarify the concepts.

Objectives

Upon completion of this course it is expected that students will be able understand,

- The basic concepts in biopharmaceutics and pharmacokinetics.
- The use raw data and derive the pharmacokinetic models and parameters the best describe the process of drug absorption, distribution, metabolism and elimination.
- The critical evaluation of biopharmaceutic studies involving drug product equivalency.
- The design and evaluation of dosage regimens of the drugs using pharmacokinetic and biopharmaceutic parameters.
- The potential clinical pharmacokinetic problems and application of basics of pharmacokinetic

THEORY 60 Hrs

1. Drug Absorption from the Gastrointestinal Tract: Gastrointestinal tract, Mechanism of drug absorption, Factors affecting drug absorption, pH–partition theory of drug absorption. Formuulation and physicochemical factors: Dissolution rate, Dissolution process, Noyes–Whitney equation and drug dissolution, Factors affecting the dissolution rate. Gastrointestinal absorption: role of the dosage form: Solution (elixir, syrup and solution) as a dosage form ,Suspension as a dosage form, Capsule as a dosage form, Tablet as a dosage form ,Dissolution methods ,Formulation and processing factors, Correlation of in vivo data with in vitro dissolution data.Transport model: Permeability-Solubility-Charge State and the pH Partition Hypothesis, Properties of the Gastrointestinal Tract (GIT), pH Microclimate Intracellular pH Environment, Tight-Junction Complex. 12 Hrs

2	Biopharmaceutic considerations in drug product design and In Vitro Drug Product Performance: Introduction, biopharmaceutic factors affecting drug bioavailability, rate-limiting steps in drug absorption, physicochemical nature of the drug formulation factors affecting drug product performance, in vitro: dissolution and drug release testing, compendial methods of dissolution, alternative methods of dissolution testing,meeting dissolution requirements,problems of variable control in dissolution testingperformance of drug products. In vitro-in vivo correlation, dissolution profile comparisons, drug product stability,considerations in the design of a drug product.	12 Hrs
3	Pharmacokinetics: Basic considerations, pharmacokinetic models, compartment modeling: one compartment model- IV bolus, IV infusion, extra-vascular. Multi compartment model:two compartment - model in brief, non-linear pharmacokinetics: cause of non-linearity, Michaelis - Menten equation, estimation of k_{max} and v_{max}. Drug interactions: introduction, the effect of protein-binding interactions,the effect of tissue-binding interactions,cytochrome p450-based drug interactions,drug interactions linked to transporters.	12 Hrs
4	Drug Product Performance, In Vivo: Bioavailability and Bioequivalence: drug product performance, purpose of bioavailability studies, relative and absolute availability. methods for assessing bioavailability, bioequivalence studies, design and evaluation of bioequivalence studies, study designs, crossover study designs, evaluation of the data, bioequivalence example, study submission and drug review process. biopharmaceutics classification system, methods. Permeability: In-vitro, in-situ and In-vivo methods.generic biologics (biosimilar drug products),clinical significance of bioequivalence studies, special concerns in bioavailability and bioequivalence studies, generic substitution.	12 Hrs
5	Application of Pharmacokinetics: Modified-Release Drug Products, Targeted Drug Delivery Systems and Biotechnological Products. Introduction to Pharmacokinetics and pharmacodynamic, drug interactions. Pharmacokinetics and pharmacodynamics of biotechnology drugs. Introduction, Proteins and peptides, Monoclonal antibodies, Oligonucleotides, Vaccines (immunotherapy), Gene therapies.	12 Hrs

REFERENCES

1. Biopharmaceutics and Clinical Pharmacokinetics by Milo Gibaldi, 4th edition,Philadelphia, Lea and Febiger, 1991
2. Biopharmaceutics and Pharmacokinetics, A. Treatise, D .M. Brahmankar and Sunil B. Jaiswal., VallabPrakashan, Pitampura, Delhi
3. Applied Biopharmaceutics and Pharmacokinetics by Shargel. Land YuABC, 2nd edition, Connecticut Appleton Century Crofts, 1985
4. Textbook of Biopharmaceutics and Pharmacokinetics, Dr. Shobha Rani R. Hiremath,Prism Book
5. Pharmacokinetics by Milo Gibaldi and D. Perrier, 2nd edition, Marcel Dekker Inc.,New York, 1982
6. Current Concepts in Pharmaceutical Sciences: Biopharmaceutics, Swarbrick. J, Leaand Febiger, Philadelphia, 1970
7. Clinical Pharmacokinetics, Concepts and Applications 3rd edition by MalcolmRowland and Thom~N. Tozer, Lea and Febiger, Philadelphia, 1995
8. Dissolution, Bioavailability and Bioequivalence, Abdou. H.M, Mack PublishingCompany, Pennsylvania 1989
9. Biopharmaceutics and Clinical Pharmacokinetics, An Introduction, 4th edition,revised and expande by Robert. E. Notari, Marcel Dekker Inc, New York and Basel,1987.
10. Biopharmaceutics and Relevant Pharmacokinetics by John. G Wagner and M.Pemarowski, 1st edition, Drug Intelligence Publications, Hamilton, Illinois, 1971.
11. Encyclopedia of Pharmaceutical Technology, Vol 13, James Swarbrick, James. G.Boylan, Marcel Dekker Inc, New York, 1996.
12. Basic Pharmacokinetics,1 st edition,Sunil S JambhekarandPhilip J Breen,pharmaceutical press, RPS Publishing,2009.
13. Absorption and Drug Development- Solubility, Permeability, and Charge State, Alex Avdeef, John Wiley & Sons, Inc,2003.

COMPUTER AIDED DRUG DEVELOPMENT
(MPH 203T)

Scope

This course is designed to impart knowledge and skills necessary for computer Applications in pharmaceutical research and development who want to understand the application of computers across the entire drug research and development process. Basic theoretical discussions of the principles of more integrated and coherent use of computerized information (informatics) in the drug development process are provided to help the students to clarify the concepts.

Objectives

Upon completion of this course it is expected that students will be able to understand,

- History of Computers in Pharmaceutical Research and Development
- Computational Modeling of Drug Disposition
- Computers in Preclinical Development
- Optimization Techniques in Pharmaceutical Formulation
- Computers in Market Analysis
- Computers in Clinical Development
- Artificial Intelligence (AI) and Robotics
- Computational fluid dynamics(CFD)

THEORY		60 Hrs
1.	a. Computers in Pharmaceutical Research and Development: A General Overview: History of Computers in Pharmaceutical Research and Development. Statistical modeling in Pharmaceutical research and development: Descriptive versus Mechanistic Modeling, Statistical Parameters, Estimation, Confidence Regions, Nonlinearity at the Optimum, Sensitivity Analysis, Optimal Design, Population Modeling b. Quality-by-Design In Pharmaceutical Development: Introduction, ICH Q8 guideline, Regulatory and industry views on QbD, Scientifically based QbD – examples of application.	12 Hrs
2	Computational Modeling Of Drug Disposition: Introduction ,Modeling Techniques: Drug Absorption, Solubility, Intestinal Permeation, Drug Distribution ,Drug Excretion, Active Transport; P-gp, BCRP, Nucleoside Transporters, hPEPT1, ASBT, OCT, OATP, BBB–Choline Transporter.	12 Hrs

3	Computer-aided formulation development:: Concept of optimization, Optimization parameters, Factorial design, Optimization technology & Screening design. Computers in Pharmaceutical Formulation: Development of pharmaceutical emulsions, microemulsion drug carriers Legal Protection of Innovative Uses of Computers in R&D, The Ethics of Computing in Pharmaceutical Research, Computers in Market analysis	12 Hrs
4	a. Computer-aided biopharmaceutical characterization: Gastrointestinal absorption simulation. Introduction, Theoretical background, Model construction, Parameter sensitivity analysis, Virtual trial, Fed vs. fasted state, In vitro dissolution and in vitro-in vivo correlation, Biowaiver considerations b. Computer Simulations in Pharmacokinetics and Pharmacodynamics: Introduction, Computer Simulation: Whole Organism, Isolated Tissues, Organs, Cell, Proteins and Genes. c. Computers in Clinical Development: Clinical Data Collection and Management, Regulation of Computer Systems	12 Hrs
5	Artificial Intelligence (AI), Robotics and Computational fluid dynamics: General overview, Pharmaceutical Automation, Pharmaceutical applications, Advantages and Disadvantages. Current Challenges and Future Directions.	12 Hrs

REFERENCES

1. Computer Applications in Pharmaceutical Research and Development, Sean Ekins, 2006, John Wiley & Sons.
2. Computer-Aided Applications in Pharmaceutical Technology, 1st Edition, Jelena Djuris, Woodhead Publishing
3. Encyclopedia of Pharmaceutical Technology, Vol 13, James Swarbrick, James. G.Boylan, Marcel Dekker Inc, New York, 1996.

COSMETICS AND COSMECEUTICALS
(MPH 204T)

Scope

This course is designed to impart knowledge and skills necessary forthefundamental need for cosmetic and cosmeceutical products.

Objectives

Upon completion of the course, the students shall be able to understand

- Key ingredients used in cosmetics and cosmeceuticals.
- Key building blocks for various formulations.
- Current technologies in the market
- Various key ingredients and basic science to develop cosmetics and cosmeceuticals
- Scientific knowledge to develop cosmetics and cosmeceuticals with desired Safety, stability, and efficacy.

THEORY 60 Hrs

1. Cosmetics – Regulatory : Definition of cosmetic products as per Indian regulation. Indian regulatory requirements for labeling of cosmetics Regulatory provisions relating to import of cosmetics., Misbranded and spurious cosmetics. Regulatory provisions relating to manufacture of cosmetics – Conditions for obtaining license, prohibition of manufacture and sale of certain cosmetics, loan license, offences and penalties. 12 Hrs

2 Cosmetics - Biological aspects : Structure of skin relating to problems like dry skin, acne, pigmentation, prickly heat, wrinkles and body odor. Structure of hair and hair growth cycle. Common problems associated with oral cavity. Cleansing and care needs for face, eye lids, lips, hands, feet, nail, scalp, neck, body and under-arm. 12 Hrs

3 Formulation Building blocks: Building blocks for different product formulations of cosmetics/cosmeceuticals. Surfactants – Classification and application. Emollients, rheological additives: classification and application. Antimicrobial used as preservatives, their merits and demerits. Factors affecting microbial preservative efficacy. Building blocks for formulation of a moisturizing cream, vanishing cream, cold cream, shampoo and toothpaste. Soaps and syndetbars. 12 Hrs

Perfumes; Classification of perfumes. Perfume ingredients listed as allergens in EU regulation.

	Controversial ingredients: Parabens, formaldehyde liberators, dioxane.	
4	Design of cosmeceutical products: Sun protection, sunscreens classification and regulatory aspects. Addressing dry skin, acne, sun-protection, pigmentation, prickly heat, wrinkles, body odor., dandruff, dental cavities, bleeding gums, mouth odor and sensitive teeth through cosmeceutical formulations.	12 Hrs
5	Herbal Cosmetics : Herbal ingredients used in Hair care, skin care and oral care. Review of guidelines for herbal cosmetics by private bodies like cosmos with respect to preservatives, emollients, foaming agents, emulsifiers and rheology modifiers. Challenges in formulating herbal cosmetics.	12 Hrs

REFERENCES

1. Harry's Cosmeticology. 8th edition.
2. Poucher'sperfumecosmeticsandSoaps,10th edition.
3. Cosmetics – Formulation, Manufacture and quality control, PP.Sharma,4th edition
4. Handbook of cosmetic science and Technology A.O.Barel, M.Paye and H.I. Maibach. 3 rd edition
5. Cosmetic and Toiletries recent suppliers catalogue.
6. CTFA directory.

PHARMACEUTICS PRACTICALS - II

(MPH 205P)

1. To study the effect of temperature change , non solvent addition, incompatible polymer addition in microcapsules preparation
2. Preparation and evaluation of Alginate beads
3. Formulation and evaluation of gelatin /albumin microspheres
4. Formulation and evaluation of liposomes/niosomes
5. Formulation and evaluation of spherules
6. Improvement of dissolution characteristics of slightly soluble drug by Solid dispersion technique.
7. Comparison of dissolution of two different marketed products /brands
8. Protein binding studies of a highly protein bound drug & poorly protein bound drug
9. Bioavailability studies of Paracetamol in animals.
10. Pharmacokinetic and IVIVC data analysis by Winnoline^{R} software
11. In vitro cell studies for permeability and metabolism
12. DoE Using Design Expert® Software
13. Formulation data analysis Using Design Expert® Software
14. Quality-by-Design in Pharmaceutical Development
15. Computer Simulations in Pharmacokinetics and Pharmacodynamics
16. Computational Modeling Of Drug Disposition
17. To develop Clinical Data Collection manual
18. To carry out Sensitivity Analysis, and Population Modeling.
19. Development and evaluation of Creams
20. Development and evaluation of Shampoo and Toothpaste base
21. To incorporate herbal and chemical actives to develop products
22. To address Dry skin, acne, blemish, Wrinkles, bleeding gums and dandruff

Semester III

MRM 301T - Research Methodology & Biostatistics

UNIT – I

General Research Methodology: Research, objective, requirements, practical difficulties, review of literature, study design, types of studies, strategies to eliminate errors/bias, controls, randomization, crossover design, placebo, blinding techniques.

UNIT – II

Biostatistics: Definition, application, sample size, importance of sample size, factors influencing sample size, dropouts, statistical tests of significance, type of significance tests, parametric tests(students "t" test, ANOVA, Correlation coefficient, regression), non-parametric tests (wilcoxan rank tests, analysis of variance, correlation, chi square test), null hypothesis, P values, degree of freedom, interpretation of P values.

UNIT – III

Medical Research: History, values in medical ethics, autonomy, beneficence, non-maleficence, double effect, conflicts between autonomy and beneficence/non-maleficence, euthanasia, informed consent, confidentiality, criticisms of orthodox medical ethics, importance of communication, control resolution, guidelines, ethics committees, cultural concerns, truth telling, online business practices, conflicts of interest, referral, vendor relationships, treatment of family members, sexual relationships, fatality.

UNIT – IV

CPCSEA guidelines for laboratory animal facility: Goals, veterinary care, quarantine, surveillance, diagnosis, treatment and control of disease, personal hygiene, location of animal facilities to laboratories, anesthesia, euthanasia, physical facilities, environment, animal husbandry, record keeping, SOPs, personnel and training, transport of lab animals.

UNIT – V

Declaration of Helsinki: History, introduction, basic principles for all medical research, and additional principles for medical research combined with medical care.

CHAPTER –I:REGULATIONS

1. Short Title and Commencement

These regulations shall be called as "The Revised Regulations for the Master of Pharmacy (M. Pharm.)Degree Program – Credit Based Semester System (CBSS) of the Pharmacy Council of India, New Delhi". They shall come into effect from the Academic Year 2016-17. The regulations framed are subject to modifications from time to time by the authorities of the university.

2. Minimum qualification for admission

A Pass in the following examinations

a) B. Pharm Degree examination of an Indian university established by law in India from an institution approved by Pharmacy Council of India and has scored not less than 55% of the maximum marks (aggregate of 4 years of B.Pharm.)

b) Every student, selected for admission to post graduate pharmacy program in any PCI approved institution should have obtained registration with the State Pharmacy Council or should obtain the same within one month from the date of his/her admission, failing which the admission of the candidate shall be cancelled.

Note: It is mandatory to submit a migration certificate obtained from the respective university where the candidate had passed his/her qualifying degree (B.Pharm.)

3. Duration of the program

The program of study for M.Pharm. shall extend over a period of four semesters (two academic years). The curricula and syllabi for the program shall be prescribed from time to time by Phamacy Council of India, New Delhi.

4. Medium of instruction and examinations

Medium of instruction and examination shall be in English.

5. Working days in each semester

Each semestershall consist of not less than 100 working days. The odd semesters shall be conducted from the month of June/July to November/December and the even semesters shall be conducted from the month of December/January to May/June in every calendar year.

6. Attendance and progress

A candidate is required to put in at least 80% attendance in individual courses considering theory and practical separately. The candidate shall complete the prescribed course satisfactorily to be eligible to appear for the respective examinations.

7. Program/Course credit structure

As per the philosophy of Credit Based Semester System, certain quantum of academic work viz. theory classes, practical classes, seminars, assignments, etc. are measured in terms of credits. On satisfactory completion of the courses, a candidate earns credits. The amount of credit associated with a course is dependent upon the number of hours of instruction per week in that course. Similarly the credit associated with any of the other academic, co/extra-curricular activities is dependent upon the quantum of work expected to be put in for each of these activities per week/per activity.

7.1. Credit assignment

7.1.1. Theory and Laboratory courses

Courses are broadly classified as Theory and Practical. Theory courses consist of lecture (L) and Practical (P) courses consist of hours spent in the laboratory. Credits (C) for a course is dependent on the number of hours of instruction per week in that course, and is obtained by using a multiplier of one (1) for lecture and a multiplier of half (1/2) for practical (laboratory) hours.Thus, for example, a theory course having four lectures per week throughout the semester carries a credit of 4. Similarly, a practical having four laboratory hours per week throughout semester carries a credit of 2.
The contact hours of seminars, assignments and research work shall be treated as that of practical courses for the purpose of calculating credits. i.e., the contact hours shall be multiplied by 1/2. Similarly, the contact hours of journal club, research work presentations and discussions with the supervisor shall be considered as theory course and multiplied by 1.

7.2. Minimum credit requirements

The minimum credit points required for the award of M. Pharm. degree is 95. However based on the credit points earned by the students under the head of co-curricular activities, a student shall earn a maximum of 100 credit points. These credits are divided into Theory courses, Practical, Seminars, Assignments, Research work, Discussions with the supervisor, Journal club and Co-Curricular activities over the duration of four semesters. The credits

are distributed semester-wise as shown in Table 9. Courses generally progress in sequence, building competencies and their positioning indicates certain academic maturity on the part of the learners. Learners are expected to follow the semester-wise schedule of courses given in the syllabus.

8. Academic work

A regular record of attendance both in Theory, Practical, Seminar, Assignment, Journal club, Discussion with the supervisor, Research work presentation and Dissertation shall be maintained by the department / teaching staff of respective courses.

9. Course of study

The specializations in M.Pharm program is given in Table 1.

Table – 1: List of M.Pharm. Specializations and their Code

S. No.	Specialization	Code
1.	Pharmaceutics	MPH
2.	Pharmaceutical Chemistry	MPC
3.	Pharmaceutical Regulatory Affairs	MRA
4.	Pharmacology	MPL
5.	Pharmacognosy	MPG

The course of study for M.Pharm specializations shall include Semester wise Theory & Practical as given in Table – 2 . The number of hours to be devoted to each theory and practical course in any semester shall not be less than that shown in Table – 2 .

Table – 2: Course of study for M. Pharm. (Pharmacognosy)

Course Code	Course	Credit Hours	Credit Points	Hrs./wk	Marks
Semester I					
MPG101T	Modern Pharmaceutical Analytical Techniques	4	4	4	100
MPG102T	Advanced Pharmacognosy-1	4	4	4	100
MPG103T	Phytochemistry	4	4	4	100
MPG104T	Industrial Pharmacognostical Technology	4	4	4	100
MPG105P	Pharmacognosy Practical I	12	6	12	150
-	Seminar/Assignment	7	4	7	100
Total		35	26	35	650
Semester II					
MPG201T	Medicinal Plant biotechnology	4	4	4	100
MPG102T	Advanced Pharmacognosy-II	4	4	4	100
MPG203T	Indian system of medicine	4	4	4	100
MPG204T	Herbal cosmetics	4	4	4	100
MPG205P	Pharmacognosy Practical II	12	6	12	150
-	Seminar/Assignment	7	4	7	100
	Total	35	26	35	650

Table – 3: Course of study for M. Pharm. III Semester
(Common for All Specializations)

Course Code	Course	Credit Hours	Credit Points
MRM 301T	Research Methodology and Biostatistics*	4	4
-	Journal club	1	1
-	Discussion / Presentation (Proposal Presentation)	2	2
-	Research Work	28	14
Total		35	21

* Non University Exam

Table – 4: Course of study for M. Pharm. IV Semester
(Common for All Specializations)

Course Code	Course	Credit Hours	Credit Points
-	Journal Club	1	1
-	Research Work	31	16
-	Discussion/Final Presentation	3	3
Total		35	20

Table – 5: Semester wise credits distribution

Semester	Credit Points
I	26
II	26
III	21
IV	20
Co-curricular Activities (Attending Conference, Scientific Presentations and Other Scholarly Activities)	Minimum=02 Maximum=07*
Total Credit Points	Minimum=95 Maximum=100*

*Credit Points for Co-curricular Activities

Table – 6: Guidelines for Awarding Credit Points for Co-curricular Activities

Name of the Activity	Maximum Credit Points Eligible / Activity
Participation in National Level Seminar/Conference/Workshop/Symposium/ Training Programs (related to the specialization of the student)	01
Participation in international Level Seminar/Conference/Workshop/Symposium/ Training Programs (related to the specialization of the student)	02
Academic Award/Research Award from State Level/National Agencies	01
Academic Award/Research Award from International Agencies	02
Research / Review Publication in National Journals (Indexed in Scopus / Web of Science)	01
Research / Review Publication in International Journals (Indexed in Scopus / Web of Science)	02

Note: International Conference: Held Outside India

International Journal: The Editorial Board Outside India

*The credit points assigned for extracurricular and or co-curricular activities shall be given by the Principals of the colleges and the same shall be submitted to the University. The criteria to acquire this credit point shall be defined by the colleges from time to time.

10. Program Committee

1. The M. Pharm. programme shall have a Programme Committee constituted by the Head of the institution in consultation with all the Heads of the departments.

2. The composition of the Programme Committee shall be as follows:

A teacher at the cadre of Professor shall be the Chairperson; One Teacher from eachM.Pharm specialization and four student representatives (two from each academic year), nominated by the Head of the institution.

3. Duties of the Programme Committee:

i. Periodically reviewing the progress of the classes.
ii. Discussing the problems concerning curriculum, syllabus and the conduct of classes.
iii. Discussing with the course teachers on the nature and scope of assessment for the course and the same shall be announced to the students at the beginning of respective semesters.

iv. Communicating its recommendation to the Head of the institution on academic matters.
v. The Programme Committee shall meet at least twice in a semester preferably at the end of each sessionalexam and before the end semester exam.

11. Examinations/Assessments

The schemes for internal assessment and end semester examinations are given in Table – 7.

11.1. End semester examinations

The End Semester Examinations for each theory and practical coursethrough semesters I to IVshall beconducted by the respective university except for the subject with asterix symbol (*) in table I and II for which examinations shall be conducted by the subject experts at college level and the marks/grades shall be submitted to the university.

Tables – 7: Schemes for internal assessments and end semester examinations

(Pharmacognosy-MPG)

Course Code	Course	Internal Assessment				End Semester Exams		Total Marks
		Continuous Mode	Sessional Exams		Total	Marks	Duration	
			Marks	Duration				
SEMESTER I								
MPG101T	Modern Pharmaceutical Analytical Techniques	10	15	1 Hr	25	75	3 Hrs	100
MPG102T	Advanced Pharmacognosy-I	10	15	1 Hr	25	75	3 Hrs	100
MPG103T	Phytochemistry	10	15	1 Hr	25	75	3 Hrs	100
MPG104T	Industrial Pharmacognostical Technology	10	15	1 Hr	25	75	3 Hrs	100
MPG105P	Pharmacognosy Practical I	20	30	6 Hrs	50	100	6 Hrs	150
-	Seminar /Assignment	-	-	-	-	-	-	100
Total								650
SEMESTER II								
MPG201T	Medicinal Plant biotechnology	10	15	1 Hr	25	75	3 Hrs	100
MPG102T	Advanced Pharmacognosy-II	10	15	1 Hr	25	75	3 Hrs	100
MPG203T	Indian system of medicine	10	15	1 Hr	25	75	3 Hrs	100
MPG204T	Herbal cosmetics	10	15	1 Hr	25	75	3 Hrs	100
MPG205P	Pharmacognosy Practical II	20	30	6 Hrs	50	100	6 Hrs	150
-	Seminar /Assignment	-	-	-	-	-	-	100
Total								650

Tables – 08: Schemes for internal assessments and end semester examinations (Semester III& IV)

Course Code	Course	Internal Assessment				End Semester Exams		Total Marks
		Continuous Mode	Sessional Exams		Total	Marks	Duration	
			Marks	Duration				
SEMESTER III								
MRM301T	Research Methodology and Biostatistics*	10	15	1 Hr	25	75	3 Hrs	100
-	Journal club	-	-	-	25	-	-	25
-	Discussion / Presentation (Proposal Presentation)	-	-	-	50	-	-	50
-	Research work*	-	-	-	-	350	1 Hr	350
Total								525
SEMESTER IV								
-	Journal club	-	-	-	25	-	-	25
-	Discussion / Presentation (Proposal Presentation)	-	-	-	75	-	-	75
-	Research work and Colloquium	-	-	-	-	400	1 Hr	400
Total								500

*Non University Examination

11.2. Internal assessment: Continuous mode

The marks allocated for Continuous mode of Internal Assessment shall be awarded as per the scheme given below.

Table – 09: Scheme for awarding internal assessment: Continuous mode

Theory	
Criteria	Maximum Marks
Attendance (Refer Table – 28)	8
Student – Teacher interaction	2
Total	10
Practical	
Attendance (Refer Table – 28	10
Based on Practical Records, Regular viva voce, etc.	10
Total	20

Table – 10: Guidelines for the allotment of marks for attendance

Percentage of Attendance	Theory	Practical
95 – 100	8	10
90 – 94	6	7.5
85 – 89	4	5
80 – 84	2	2.5
Less than 80	0	0

11.2.1. Sessional Exams

Two sessional exams shall be conducted for each theory / practical course as per the schedule fixed by the college(s). The scheme of question paper for theory and practical sessional examinations is given in the table. The average marks of two sessional exams shall be computed for internal assessment as per the requirements given in tables.

12. Promotion and award of grades

A student shall be declared PASS and eligible for getting grade in a course of M.Pharm.programme if he/she secures at least 50% marks in that particular courseincluding internal assessment.

13. Carry forward of marks

In case a student fails to secure the minimum 50% in any Theory or Practical course as specified in 8, then he/she shall reappear for the end semester examination of that course. However his/her marks of the Internal Assessment shall be carried over and he/she shall be entitled for grade obtained by him/her on passing.

14. Improvement of internal assessment

A student shall have the opportunity to improve his/her performance only once in the sessional exam component of the internal assessment. The re-conduct of the sessional exam shall be completed before the commencement of next end semester theory examinations.

15. Reexamination of end semester examinations

Reexamination of end semester examination shall be conducted as per the schedule given in table 11. The exact dates of examinations shall be notified from time to time.

Table – 11: Tentative schedule of end semester examinations

Semester	For Regular Candidates	For Failed Candidates
I and III	November / December	May / June
II and IV	May / June	November / December

16. Allowed to keep terms (ATKT):

No student shall be admitted to any examination unless he/she fulfills the norms given in 6. ATKT rules are applicable as follows:

A student shall be eligible to carry forward all the courses of I and IIsemesters till the III semester examinations. However, he/she shall not be eligible to attend the courses of IV semester until all the courses of I, II and III semesters are successfully completed.

A student shall be eligible to get his/her CGPA upon successful completion of the courses of I to IV semesters within the stipulated time period as per the norms.

Note: Grade AB should be considered as failed and treated as one head for deciding ATKT. Such rules are also applicable for those students who fail to register for examination(s) of any course in any semester.

17. Grading of performances

17.1. Letter grades and grade points allocations:

Based on the performances, each student shall be awarded a final letter grade at the end of the semester for each course.The letter grades and their corresponding grade points are given in Table – 12.

Table – 12: Letter grades and grade points equivalent to Percentage of marks and performances

Percentage of Marks Obtained	Letter Grade	Grade Point	Performance
90.00 – 100	O	10	Outstanding
80.00 – 89.99	A	9	Excellent
70.00 – 79.99	B	8	Good
60.00 – 69.99	C	7	Fair
50.00 – 59.99	D	6	Average
Less than 50	F	0	Fail
Absent	AB	0	Fail

A learner who remains absent for any end semester examination shall be assigned a letter grade of AB and a corresponding grade point of zero. He/she should reappear for the said evaluation/examination in due course.

18. The Semester grade point average (SGPA)

The performance of a student in a semester is indicated by a number called 'Semester Grade Point Average' (SGPA). The SGPA is the weighted average of the grade points obtainedin all the courses by the student during the semester. For example, if a student takes five courses (Theory/Practical) in a semester with credits C1, C2, C3 and C4 and the student's grade points in these courses are G1, G2, G3 and G4, respectively, and then students' SGPA is equal to:

$$SGPA = \frac{C_1G_1 + C_2G_2 + C_3G_3 + C_4G_4}{C_1 + C_2 + C_3 + C_4}$$

The SGPA is calculated to two decimal points. It should be noted that, the SGPA for any semester shall take into consideration the F and ABS grade awarded in that semester. For example if a learner has a F or ABS grade in course 4, theSGPA shall then be computed as:

$$SGPA = \frac{C_1G_1 + C_2G_2 + C_3G_3 + C_4 * ZERO}{C_1 + C_2 + C_3 + C_4}$$

19. Cumulative Grade Point Average (CGPA)

The CGPA is calculated with the SGPA of all the IV semesters to two decimal points and is indicated in final grade report card/final transcript showing the grades of all IV semesters and their courses. The CGPA shall reflect the failed statusin case of F grade(s), tillthe course(s) is/are passed. When the course(s) is/are passedby obtaining a pass grade on subsequent examination(s) theCGPA

shall only reflect the new grade and not the fail grades earned earlier. The CGPA is calculated as:

$$CGPA = \frac{C_1S_1 + C_2S_2 + C_3S_3 + C_4S_4}{C_1 + C_2 + C_3 + C_4}$$

where C_1, C_2, C_3,.... is the total number of credits for semester I,II,III,.... and S_1,S_2, S_3,....is the SGPA of semester I,II,III,.... .

20. Declaration of class

The class shall be awarded on the basis of CGPA as follows:

First Class with Distinction = CGPA of. 7.50 and above
First Class = CGPA of 6.00 to 7.49
Second Class = CGPA of 5.00 to 5.99

21. Project work

All the students shall undertake a project under the supervision of a teacher in Semester III to IV and submit a report. 4 copies of the project report shall be submitted (typed & bound copy not less than 75 pages).

The internal and external examiner appointed by the University shall evaluate the project at the time of the Practical examinations of other semester(s). The projects shall be evaluated as per the criteria given below.

Evaluation of Dissertation Book:

Objective(s) of the work done	50 Marks
Methodology adopted	150 Marks
Results and Discussions	250 Marks
Conclusions and Outcomes	50 Marks
Total	500 Marks

Evaluation of Presentation:

Presentation of work	100 Marks
Communication skills	50 Marks
Question and answer skills	100 Marks
Total	250 Marks

22. Award of Ranks

Ranks and Medals shall be awarded on the basis of final CGPA. However, candidates who fail in one or more courses during the M.Pharm program shall not be eligible for award of ranks. Moreover, the candidates should have completed the M. Pharm program in minimum prescribed number of years, (two years) for the award of Ranks.

23. Award of degree

Candidates who fulfill the requirements mentioned above shall be eligible for award of degree during the ensuing convocation.

24. Duration for completion of the program of study

The duration for the completion of the program shall be fixed as double the actual duration of the program and the students have to pass within the said period, otherwise they have to get fresh Registration.

25. Revaluation I Retotaling of answer papers

There is no provision for revaluation of the answer papers in any examination. However, the candidates can apply for retotaling by paying prescribed fee.

26. Re-admission after break of study

Candidate who seeks re-admission to the program after break of study has to get the approval from the university by paying a condonation fee.

PHARMACOGNOSY (MPG)

MODERN PHARMACEUTICAL ANALYTICAL TECHNIQUES (MPG 101T)

Scope

This subject deals with various advanced analytical instrumental techniques for identification, characterization and quantification of drugs. Instruments dealt are NMR, Mass spectrometer, IR, HPLC, GC etc.

Objectives

After completion of course student is able to know,

- The analysis of various drugs in single and combination dosage forms
- Theoretical and practical skills of the instruments

THEORY 60 Hrs

1. UV-Visible spectroscopy: Introduction, Theory, Laws, Instrumentation associated with UV-Visible spectroscopy, Choice of solvents and solvent effect and Applications of UV-Visible spectroscopy. 12 Hrs

   IR spectroscopy: Theory, Modes of Molecular vibrations, Sample handling, Instrumentation of Dispersive and Fourier – Transform IR Spectrometer, Factors affecting vibrational frequencies and Applications of IR spectroscopy

   Spectroflourimetry: Theory of Fluorescence, Factors affecting fluorescence, Quenchers, Instrumentation and Applications of fluorescence spectrophotometer.

   Flame emission spectroscopy and Atomic absorption spectroscopy: Principle, Instrumentation, Interferences and Applications.

2 NMR spectroscopy: Quantum numbers and their role in NMR, Principle, Instrumentation, Solvent requirement in NMR, Relaxation process, NMR signals in various compounds, Chemical shift, Factors influencing chemical shift, Spin-Spin coupling, Coupling constant, Nuclear magnetic double resonance, Brief outline of principles of FT-NMR and 13C NMR. Applications of NMR spectroscopy.1 12 Hrs

3	Mass Spectroscopy: Principle, Theory, Instrumentation of Mass Spectroscopy, Different types of ionization like electron impact, chemical, field, FAB and MALDI, APCI, ESI, APPI Analyzers of Quadrupole and Time of Flight, Mass fragmentation and its rules, Meta stable ions, Isotopic peaks and Applications of Mass spectroscopy.	10 Hrs
4	Chromatography: Principle, apparatus, instrumentation, chromatographic parameters, factors affecting resolution, isolation of drug from excipients, data interpretation and applications of the following: a) Thin Layer chromatography b) High Performance Thin Layer Chromatography c) Ion exchange chromatography d) Column chromatography e) Gas chromatography f) High Performance Liquid chromatography g) Ultra High Performance Liquid chromatography h) Affinity chromatography i) Gel Chromatography	10 Hrs
5	Electrophoresis: Principle, Instrumentation, Working conditions, factors affecting separation and applications of the following: a) Paper electrophoresis b) Gel electrophoresis c) Capillary electrophoresis d) Zone electrophoresis e) Moving boundary electrophoresis f) Iso electric focusing X ray Crystallography: Production of X rays, Different X ray methods, Bragg's law, Rotating crystal technique, X ray powder technique, Types of crystals and applications of X-ray diffraction.	10 Hrs
6	Potentiometry: Principle, working, Ion selective Electrodes and Application of potentiometry. Thermal Techniques: Principle, thermal transitions and Instrumentation (Heat flux and power-compensation and designs), Modulated DSC, Hyper DSC, experimental parameters (sample preparation, experimental conditions, calibration, heating and	10 Hrs

cooling rates, resolution, source of errors) and their influence, advantage and disadvantages, pharmaceutical applications. Differential Thermal Analysis (DTA): Principle, instrumentation and advantage and disadvantages, pharmaceutical applications, derivative differential thermal analysis (DDTA). TGA: Principle, instrumentation, factors affecting results, advantage and disadvantages, pharmaceutical applications.

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3. Instrumental methods of analysis – Willards, 7th edition, CBS publishers.
4. Practical Pharmaceutical Chemistry – Beckett and Stenlake, Vol II, 4th edition, CBS Publishers, New Delhi, 1997.
5. Organic Spectroscopy – William Kemp, 3rd edition, ELBS, 1991.
6. Quantitative Analysis of Drugs in Pharmaceutical formulation – P D Sethi, 3rd Edition, CBS Publishers, New Delhi, 1997.
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8. Spectroscopy of Organic Compounds, 2nd edn., P.S/Kalsi, Wiley estern Ltd., Delhi.

ADVANCED PHARMACOGNOSY - I
(MPG 102T)

SCOPE

To learn and understand the advances in the field of cultivation and isolation of drugs of natural origin, various phytopharmaceuticals, nutraceuticals and their medicinal use and health benefits.

OBJECTIVES

Upon completion of the course, the student shall be able to know the,

- advances in the cultivation and production of drugs
- various phyto-pharmaceuticals and their source, its utilization and medicinal value.
- various nutraceuticals/herbs and their health benefits
- Drugs of marine origin
- Pharmacovigilance of drugs of natural origin

THEORY 60 Hrs

1. Plant drug cultivation: General introduction to the importance of Pharmacognosy in herbal drug industry, Indian Council of Agricultural Research, Current Good Agricultural Practices, Current Good Cultivation Practices, Current Good Collection Practices, Conservation of medicinal plants- Ex-situ and In-situ conservation of medicinal plants. — 12 Hrs

2 Marine natural products: General methods of isolation and purification, Study of Marine toxins, Recent advances in research in marine drugs, Problems faced in research on marine drugs such as taxonomical identification, chemical screening and their solution. — 12 Hrs

3 Nutraceuticals: Current trends and future scope, Inorganic mineral supplements, Vitamin supplements, Digestive enzymes, Dietary fibres, Cereals and grains, Health drinks of natural origin, Antioxidants, Polyunsaturated fatty acids, Herbs as functional foods, Formulation and standardization of neutraceuticals, Regulatory aspects, FSSAI guidelines, Sources, name of marker compounds and their chemical nature, medicinal uses and health benefits of following — 12 Hrs

i) Spirulina ii) Soya bean iii) Ginseng iv) Garlic v) Broccoli vi) Green and Herbal Tea vii) Flax seeds viii) Black cohosh ix) Turmeric.

4 Phytopharmaceuticals: Occurrence, isolation and characteristic features (Chemical nature, uses in pharmacy, medicinal and health benefits) of following. 12 Hrs

a) Carotenoids – i) α and β – Carotene ii) Xanthophyll (Lutein)
b) Limonoids – i) d–Limonene ii) α – Terpineol
c) Saponins – i) Shatavarins
d) Flavonoids – i) Resveratrol ii) Rutin iii) Hesperidin iv) Naringin v) Quercetin
e) Phenolic acids– Ellagic acid
f) Vitamins
g) Tocotrienols and Tocopherols
h) Andrographolide, Glycolipids, Gugulipids, Withanolides, Vascine, Taxol
i) Miscellaneous

5 Pharmacovigilance of drugs of natural origin: WHO and AYUSH guidelines for safety monitoring of natural medicine, Spontaneous reporting schemes for biodrug adverse reactions, bio drug–drug and bio drug–food interactions with suitable examples. 12 Hrs

REFERENCES (Latest Editions of)

1. Pharmacognosy – G. E. Trease and W.C. Evans. Saunders Edinburgh, New York.
2. Pharmacognosy-Tyler, Brady, Robbers
3. Modem Methods of Plant Analysis– Peach & M.V. Tracey, Vol. I&II
4. Text Book of Pharmacognosy by T.E. Wallis
5. Marine Natural Products-Vol.I to IV.
6. Natural products: A lab guide by Raphael Ikan , Academic Press 1991.
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10. Herbal Drug Industry by RD. Choudhary, Eastern Publisher, New Delhi, 1996.
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14. Natural Products from Plants, 1st edition, by Peter B. Kaufman, CRC Press, New York, 1998
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PHYTOCHEMISTRY
(MPG 103T)

SCOPE

Students shall be equipped with the knowledge of natural product drug discovery and will be able to isolate, identify and extract and the phyto-constituents

OBJECTIVES

Upon completion of the course, the student shall be able to know the,

- different classes of phytoconstituents, their biosynthetic pathways, their properties, extraction and general process of natural product drug discovery
- phytochemical fingerprinting and structure elucidation of phytoconstituents.

THEORY 60 Hrs

1. Biosynthetic pathways and Radio tracing techniques: Constituents & their Biosynthesis, Isolation, Characterization and purification with a special reference to their importance in herbal industries of following phyto-pharmaceuticals containing drugs: 12 Hrs
   a) Alkaloids: Ephedrine, Quinine, Strychynine, Piperine, Berberine, Taxol, Vinca alkoloids.
   b) Glycosides: Digitoxin, Glycyrrhizin, Sennosides, Bacosides, Quercitin.
   c) Steroids: Hecogenin, guggulosterone and withanolides
   d) Coumarin: Umbelliferone.
   e) Terpenoids: Cucurbitacins

2 Drug discovery and development: History of herbs as source of drugs and drug discovery, the lead structure selection process, structure development, product discovery process and drug registration, Selection and optimization of lead compounds with suitable examples from the following source : artemesin, andrographolides. Clinical studies emphasising on phases of clinical trials, protocol design for lead molecules. 12 Hrs

3 Extraction and Phytochemical studies: Recent advances in extractions with emphasis on selection of method and choice of solvent for extraction, successive and exhaustive extraction and other methods of extraction commonly used like microwave 12 Hrs

assisted extraction, Methods of fractionation. Separation of phytoconstituents by latest CCCET, SCFE techniques including preparative HPLC and Flash column chromatography.

4	Phytochemical finger printing: HPTLC and LCMS/GCMS applications in the characterization of herbal extracts. Structure elucidation of phytoconstituents.	12 Hrs
5	Structure elucidation of the following compounds by spectroscopic techniques like UV, IR, MS, NMR (1H, 13C) a. Carvone, Citral, Menthol b. Luteolin, Kaempferol c. Nicotine, Caffeine iv) Glycyrrhizin.	12 Hrs

REFERENCES (Latest Editions of)

1. Organic chemistry by I.L. Finar Vol.II
2. Pharmacognosy by Trease and Evans, ELBS.
3. Pharmacognosy by Tylor and Brady.
4. Text book of Pharmacognosy by Wallis.
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10. Organic Chemistry of Natural Products, Vol. 1&2. Gurdeep R Chatwal.
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INDUSTRIAL PHARMACOGNOSTICAL TECHNOLOGY
(MPG 104T)

SCOPE

To understand the Industrial and commercial potential of drugs of natural origin, integrate traditional Indian systems of medicine with modern medicine and also to know regulatory and quality policy for the trade of herbals and drugs of natural origin.

OBJECTIVES

By the end of the course the student shall be able to know,

- the requirements for setting up the herbal/natural drug industry.
- the guidelines for quality of herbal/natural medicines and regulatory issues.
- the patenting/IPR of herbals/natural drugs and trade of raw and finished materials.

THEORY 60 Hrs

1. Herbal drug industry: Infrastructure of herbal drug industry involved in production of standardized extracts and various dosage forms. Current challenges in upgrading and modernization of herbal formulations. Entrepreneurship Development, Project selection, project report, technical knowledge, Capital venture, plant design, layout and construction. Pilot plant scale –up techniques, case studies of herbal extracts. Formulation and production management of herbals. 12 Hrs

2 Regulatory requirements for setting herbal drug industry: Global marketing management. Indian and international patent law as applicable herbal drugs and natural products. Export – Import (EXIM) policy, TRIPS. 12 Hrs

Quality assurance in herbal/natural drug products.
Concepts of TQM, GMP, GLP, ISO-9000.

3 Monographs of herbal drugs: General parameters of monographs of herbal drugs and comparative study in IP, USP, Ayurvedic Pharmacopoeia, Siddha and Unani Pharmacopoeia, American herbal pharmacopoeia, British herbal pharmacopoeia, WHO guidelines in quality assessment of herbal drugs.

4	Testing of natural products and drugs: Herbal medicines – clinical laboratory testing. Stability testing of natural products, protocols.	12 Hrs
5	Patents: Indian and international patent laws, proposed amendments as applicable to herbal/natural products and process. Geographical indication, Copyright, Patentable subject maters, novelty, non obviousness, utility, enablement and best mode, procedure for Indian patent filing, patent processing, grant of patents, rights of patents, cases of patents, opposition and revocation of patents, patent search and literature, Controllers of patents.	12 Hrs

REFERENCES (Latest Editions of)

1. Herbal drug industry by R.D. Choudhary (1996), Eastern Publisher, New Delhi.
2. GMP for Botanicals – Regulatory and Quality issues on Phytomedicine by Pulok K Mukharjee (2003), Ist Edition, Business horizons Robert Verpoorte, New Delhi.
3. Quality control of herbal drugs by Pulok K Mukarjee (2002), Business Horizons Pharmaceutical Publisher, New Delhi.
4. PDR for Herbal Medicines (2000), Medicinal Economic Company, New Jersey.
5. Indian Herbal Pharmacopoeia (2002), IDMA, Mumbai.
6. Text book of Pharmacognosy by C.K. Kokate, Purohit, Gokhlae (1996), Nirali Prakashan, New Delhi.
7. Text book of Pharmacognosy and Phytochemistry by Vinod D. Rangarl (2002), Part I & II, Career Publication, Nasik, India.
8. Plant drug analysis by H.Wagner and S.Bladt, Springer, Berlin.
9. Standardization of Botanicals. Testing and extraction methods of medicinal herbs by V. Rajpal (2004), Vol.I, Eastern Publisher, New Delhi.
10. Phytochemical Dictionary. Handbook of Bioactive Compounds from Plants by J.B.Harborne, (1999), IInd Edition, Taylor and Francis Ltd, UK.
11. Herbal Medicine. Expanded Commission E Monographs by M.Blumenthal, (2004), IST Edition,
12. Drug Formulation Manual by D.P.S.Kohli and D.H.Shah (1998), Eastern Publisher, New Delhi.

PHARMACOGNOSY PRACTICAL - I
(MPG I05P)

1. Analysis of Pharmacopoeial compounds of natural origin and their formulations by UV Vis spectrophotometer
2. Analysis of recorded spectra of simple phytoconstituents
3. Experiments based on Gas Chromatography
4. Estimation of sodium/potassium by flame photometry
5. Development of fingerprint of selected medicinal plant extracts commonly used in herbal drug industry viz. Ashwagandha, Tulsi, Bael, Amla, Ginger, Aloe, Vidang, Senna, Lawsonia by TLC/HPTLC method.
6. Methods of extraction
7. Phytochemical screening
8. Demonstration of HPLC- estimation of glycerrhizin
9. Monograph analysis of clove oil
10. Monograph analysis of castor oil.
11. Identification of bioactive constituents from plant extracts
12. Formulation of different dosage forms and their standardisation.

MEDICINAL PLANT BIOTECHNOLOGY
(MPG 201T)

SCOPE

To explore the knowledge of Biotechnology and its application in the improvement of quality of medicinal plants

OBJECTIVES

Upon completion of the course, the student shall be able to,

- Know the process like genetic engineering in medicinal plants for higher yield of Phytopharmaceuticals.
- Use the biotechnological techniques for obtaining and improving the quality of natural products/medicinal plants

THEORY 60 Hrs

1. Introduction to Plant biotechnology: Historical perspectives, prospects for development of plant biotechnology as a source of medicinal agents. Applications in pharmacy and allied fields. Genetic and molecular biology as applied to pharmacognosy, study of DNA, RNA and protein replication, genetic code, regulation of gene expression, structure and complicity of genome, cell signaling, DNA recombinant technology. 12 Hrs

2 Different tissue culture techniques: Organogenesis and embryogenesis, synthetic seed and monoclonal variation, Protoplast fusion, Hairy root multiple shoot cultures and their applications. Micro propagation of medicinal and aromatic plants. Sterilization methods involved in tissue culture, gene transfer in plants and their applications. 15 Hrs

3 Immobilisation techniques & Secondary Metabolite Production: Immobilization techniques of plant cell and its application on secondary metabolite Production. Cloning of plant cell: Different methods of cloning and its applications. Advantages and disadvantages of plant cell cloning. Secondary metabolism in tissue cultures with emphasis on production of medicinal agents. Precursors and elicitors on production of secondary metabolites. 15 Hrs

4 Biotransformation and Transgenesis: Biotransformation, bioreactors for pilot and large scale cultures of plant cells and retention of biosynthetic potential in cell culture. Transgenic 13 Hrs

plants, methods used in gene identification, localization and sequencing of genes. Application of PCR in plant genome analysis.

5	Fermentation technology: Application of Fermentation technology, Production of ergot alkaloids, single cell proteins, enzymes of pharmaceutical interest.	05 Hrs

REFERENCES (Latest Editions of)

1. Plant tissue culture, Bhagwani, vol 5, Elsevier Publishers.
2. Plant cell and Tissue Culture (Lab. Manual), JRMM. Yeoman.
3. Elements in biotechnology by PK. Gupta, Rastogi Publications, New Delhi.
4. An introduction to plant tissue culture by MK. Razdan, Science Publishers.
5. Experiments in plant tissue culture by John HD and Lorin WR., Cambridge University Press.
6. Pharmaceutical biotechnology by SP. Vyas and VK. Dixit, CBS Publishers.
7. Plant cell and tissue culture by Jeffrey W. Pollard and John M Walker, Humana press.
8. Plant tissue culture by Dixon, Oxford Press, Washington DC, 1985
9. Plant tissue culture by Street.
10. Pharmacognosy by G. E. Trease and WC. Evans, Elsevier.
11. Biotechnology by Purohit and Mathur, Agro-Bio, 3rd revised edition.
12. Biotechnological applications to tissue culture by Shargool, Peter D, Shargoal, CKC Press.
13. Pharmacognosy by Varo E. Tyler, Lynn R. Brady and James E. Robberrt, That Tjen, NGO.
14. Plant Biotechnology, Ciddi Veerasham.

ADVANCED PHARMACOGNOSY - II
(MPG 202T)

SCOPE

To know and understand the Adulteration and Deterioration that occurs in herbal/natural drugs and methods of detection of the same. Study of herbal remedies and their validations, including methods of screening

OBJECTIVES

Upon completion of the course, the student shall be able to know the,

- validation of herbal remedies
- methods of detection of adulteration and evaluation techniques for the herbal drugs
- methods of screening of herbals for various biological properties

THEORY 60 Hrs

1. Herbal remedies – Toxicity and Regulations: Herbals vs Conventional drugs, Efficacy of Herbal medicine products, Validation of herbal therapies, Pharmacodynamic and Pharmacokinetic issues. 12 Hrs

2 Adulteration and Deterioration: Introduction, Types of Adulteration/ Substitution of Herbal drugs, Causes and Measures of Adulteration, Sampling Procedures, Determination of Foreign Matter, DNA Finger printing techniques in identification of drugs of natural origin, detection of heavy metals, pesticide residues, phytotoxin, microbial contamination in herbs and their formulations. 12 Hrs

3 Ethnobotany and Ethnopharmacology: Ethnobotany in herbal drug evaluation, Impact of Ethnobotany in traditional medicine, New development in herbals, Bio-prospecting tools for drug discovery, Role of Ethnopharmacology in drug evaluation, Reverse Pharmacology. 12 Hrs

4 Analytical Profiles of herbal drugs: Andrographis paniculata, Boswellia serata, Coleus forskholii, Curcuma longa, Embelica officinalis, Psoralea corylifolia. 12 Hrs

5 Biological screening of herbal drugs: Introduction and Need for Phyto-Pharmacological Screening, New Strategies for evaluating 12 Hrs

Natural Products, In vitro evaluation techniques for Antioxidants, Antimicrobial and Anticancer drugs. In vivo evaluation techniques for Anti-inflammatory, Antiulcer, Anticancer, Wound healing, Antidiabetic, Hepatoprotective, Cardio protective, Diuretics and Antifertility, Toxicity studies as per OECD guidelines.

REFERENCES (Latest Editions of)

1. Glimpses of Indian Ethano Pharmacology by P. Pushpangadam. Ulf Nyman. V.George Tropical Botanic Garden & Research Institute.
2. Natural products: A lab guide by Raphael Ikan, Academic Press.
3. Pharmacognosy – G. E. Trease and W.C. Evans. WB. Saunders Edinburgh, New York.
4. Pharmacognosy-Tyler, Brady, Robbers, Lee & Fetiger.
5. Modem Methods of Plant Analysis- Peach & M.V. Tracey, Vol. I & II, Springer Publishers.
6. Herbal Drug Industry by RD. Choudhary, Eastern Publishers, New Delhi.
7. Text book of Pharmacognosy by C.K.Kokate, Purohit, Ghokhale, Nirali Prakashan.
8. Text Book of Pharmacognosy by T.E. Wallis, J & A Churchill Ltd., London.
9. Quality control of herbal drugs by Pulok K Mukherjee, Business Horizons Pharmaceutical Publishers, New Delhi.
10. Indian Herbal Pharmacopoeia, IDMA, Mumbai.
11. Text book of Pharmacognosy and Phytochemistry by Vinod D. RangarI, Part I & II, Career Publication, Nasik, India.
12. Plant drug analysis by H.Wagner and S.Bladt, 2nd edition, Springer, Berlin.
13. Standardization of Botanicals. Testing and extraction methods of medicinal herbs by V. Rajpal (2004), Vol.I, Eastern PublisherS, New Delhi.
14. Herbal Medicine. Expanded Commission E Monographs, M.Blumenthal.

INDIAN SYSTEMS OF MEDICINE
(MPG 203T)

SCOPE

To make the students understand thoroughly the principles, preparations of medicines of various Indian systems of medicine like Ayurveda, Siddha, Homeopathy and Unani. Also focusing on clinical research of traditional medicines, quality assurance and challenges in monitoring the safety of herbal medicines.

OBJECTIVES

After completion of the course, student is able to

- To understand the basic principles of various Indian systems of medicine
- To know the clinical research of traditional medicines, Current Good Manufacturing Practice of Indian systems of medicine and their formulations.

THEORY 60 Hrs

1. Fundamental concepts of Ayurveda, Siddha, Unani and Homoeopathy systems of medicine 12 Hrs
   Different dosage forms of the ISM.
   Ayurveda: Ayurvedic Pharmacopoeia, Analysis of formulations and bio crude drugs with references to: Identity, purity and quality.
   Siddha: Gunapadam (Siddha Pharmacology), raw drugs/Dhatu/Jeevam in Siddha system of medicine, Purification process (Suddhi).

2 Naturopathy, Yoga and Aromatherapy practices 12 Hrs
   a) Naturopathy – Introduction, basic principles and treatment modalities.
   b) Yoga – Introduction and Streams of Yoga. Asanas, Pranayama, Meditations and Relaxation techniques.
   c) Aromatherapy – Introduction, aroma oils for common problems, carrier oils.

3 Formulation development of various systems of medicine 12 Hrs
   Salient features of the techniques of preparation of some of the important class of Formulations as per Ayurveda, Siddha, Homeopathy and Unani Pharmacopoeia and texts. Standardization,
   Shelf life and Stability studies of ISM formulations.

4	Schedule T – Good Manufacturing Practice of Indian systems of medicine Components of GMP (Schedule – T) and its objectives, Infrastructural requirements, working space, storage area, machinery and equipments, standard operating procedures, health and hygiene, documentation and records. Quality assurance in ISM formulation industry – GAP, GMP and GLP. Preparation of documents for new drug application and export registration. Challenges in monitoring the safety of herbal medicines: Regulation, quality assurance and control, National/Regional Pharmacopoeias.	12 Hrs
5	TKDL, Geographical indication Bill, Government bills in AYUSH, ISM, CCRAS, CCRS, CCRH, CCRU	12 Hrs

REFERENCES (Latest Editions of)

1. Ayurvedic Pharmacopoeia, The Controller of Publications, Civil Lines, Govt. of India, New Delhi.
2. Hand Book on Ayurvedic Medicines, H. Panda, National Institute of Industrial Research, New Delhi.
3. Ayurvedic System of Medicine, Kaviraj Nagendranath Sengupata, Sri Satguru Publications, New Delhi.
4. Ayurvedic Pharmacopoeia. Formulary of Ayurvedic Medicines, IMCOPS, Chennai.
5. Homeopathic Pharmacopoeia. Formulary of Homeopathic Medicines, IMCOPS, Chennai.
6. Homeopathic Pharmacy : An introduction & Hand book, Steven B. Kayne, Churchill Livingstone, New York.
7. Indian Herbal Pharmacopoeia, IDMA, Mumbai.
8. British Herbal Pharmacopoeia, bRITISH Herbal Medicine Association, UK.
9. GMP for Botanicals – Regulatory and Quality issues on Phytomedicine, Pulok K Mukharjee, Business Horizons, New Delhi.
10. Indian System of Medicine and Homeopathy in India, Planning and Evaluation Cell, Govt. of India, New Delhi.
11. Essential of Food and Nutrition, Swaminathan, Bappco, Bangalore.
12. Clinical Dietitics and Nutrition, F.P. Antia, Oxford University Press, Delhi.
13. Yoga – The Science of Holistic Living by V.K.Yoga, Vivekananda Yoga Prakashna Publishing, Bangalore.

HERBAL COSMETICS
(MPG 204T)

SCOPE

This subject deals with the study of preparation and standardization of herbal/natural cosmetics. This subject gives emphasis to various national and international standards prescribed regarding herbal cosmeceuticals.

OBJECTIVES

After completion of the course, student shall be able to,

- understand the basic principles of various herbal/natural cosmetic preparations
- current Good Manufacturing Practices of herbal/natural cosmetics as per the regulatory authorities

THEORY — 60 Hrs

1. Introduction: Herbal/natural cosmetics, Classification & Economic aspects. — 12 Hrs

   Regulatory Provisions relation to manufacture of cosmetics: – License, GMP, offences & Penalties, Import & Export of Herbal/natural cosmetics, Industries involved in the production of Herbal/natural cosmetics.

2. Commonly used herbal cosmetics, raw materials, preservatives, surfactants, humectants, oils, colors, and some functional herbs, preformulation studies, compatibility studies, possible interactions between chemicals and herbs, design of herbal cosmetic formulation. — 12 Hrs

3. Herbal Cosmetics : Physiology and chemistry of skin and pigmentation, hairs, scalp, lips and nail, Cleansing cream, Lotions, Face powders, Face packs, Lipsticks, Bath products, soaps and baby product, Preparation and standardisation of the following: — 12 Hrs

   Tonic, Bleaches, Dentifrices and Mouth washes & Tooth Pastes, Cosmetics for Nails.

4. Cosmeceuticals of herbal and natural origin: Hair growth formulations, Shampoos, Conditioners, Colorants & hair oils, Fairness formulations, vanishing & foundation creams, anti-sun burn preparations, moisturizing creams, deodorants. — 12 Hrs

5	Analysis of Cosmetics, Toxicity screening and test methods: Quality control and toxicity studies as per Drug and Cosmetics Act.	12 Hrs

REFERENCES (Latest Editions of)

1. Panda H. Herbal Cosmetics (Hand book), Asia Pacific Business Press Inc, New Delhi.
2. Thomson EG. Modern Cosmetics, Universal Publishing Corporation, Mumbai.
3. P.P.Sharma. Cosmetics – Formulation, Manufacturing & Quality Control, Vandana Publications, New Delhi.
4. Supriya K B. Handbook of Aromatic Plants, Pointer Publishers, Jaipur.
5. Skaria P. Aromatic Plants (Horticulture Science Series), New India Publishing Agency, New Delhi.
6. Kathi Keville and Mindy Green. Aromatheraphy (A Complete Guide to the Healing Art), Sri Satguru Publications, New Delhi.
7. Chattopadhyay PK. Herbal Cosmetics & Ayurvedic Medicines (EOU), National Institute of Industrial Research, Delhi.
8. Balsam MS & Edward Sagarin. Cosmetics Science and Technology, Wiley Interscience, New York.

HERBAL COSMETICS PRACTICALS
(MPG 205P)

1. Isolation of nucleic acid from cauliflower heads
2. Isolation of RNA from yeast
3. Quantitative estimation of DNA
4. Immobilization technique
5. Establishment of callus culture
6. Establishment of suspension culture
7. Estimation of aldehyde contents of volatile oils
8. Estimation of total phenolic content in herbal raw materials
9. Estimation of total alkaloid content in herbal raw materials
10. Estimation of total flavonoid content in herbal raw materials
11. Preparation and standardization of various simple dosage forms from Ayurvedic, Siddha, Homoeopathy and Unani formulary
12. Preparation of certain Aromatherapy formulations
13. Preparation of herbal cosmetic formulation such as lip balm, lipstick, facial cream, herbal hair and nail care products
14. Evaluation of herbal tablets and capsules
15. Preparation of sunscreen, UV protection cream, skin care formulations.
16. Formulation & standardization of herbal cough syrup.

Semester III

MRM 301T - Research Methodology & Biostatistics

UNIT – I

General Research Methodology: Research, objective, requirements, practical difficulties, review of literature, study design, types of studies, strategies to eliminate errors/bias, controls, randomization, crossover design, placebo, blinding techniques.

UNIT – II

Biostatistics: Definition, application, sample size, importance of sample size, factors influencing sample size, dropouts, statistical tests of significance, type of significance tests, parametric tests(students "t" test, ANOVA, Correlation coefficient, regression), non-parametric tests (wilcoxan rank tests, analysis of variance, correlation, chi square test), null hypothesis, P values, degree of freedom, interpretation of P values.

UNIT – III

Medical Research: History, values in medical ethics, autonomy, beneficence, non-maleficence, double effect, conflicts between autonomy and beneficence/non-maleficence, euthanasia, informed consent, confidentiality, criticisms of orthodox medical ethics, importance of communication, control resolution, guidelines, ethics committees, cultural concerns, truth telling, online business practices, conflicts of interest, referral, vendor relationships, treatment of family members, sexual relationships, fatality.

UNIT – IV

CPCSEA guidelines for laboratory animal facility: Goals, veterinary care, quarantine, surveillance, diagnosis, treatment and control of disease, personal hygiene, location of animal facilities to laboratories, anesthesia, euthanasia, physical facilities, environment, animal husbandry, record keeping, SOPs, personnel and training, transport of lab animals.

UNIT – V

Declaration of Helsinki: History, introduction, basic principles for all medical research, and additional principles for medical research combined with medical care.

CHAPTER –I:REGULATIONS

1. Short Title and Commencement

These regulations shall be called as "The Revised Regulations for the Master of Pharmacy (M. Pharm.)Degree Program – Credit Based Semester System (CBSS) of the Pharmacy Council of India, New Delhi". They shall come into effect from the Academic Year 2016-17. The regulations framed are subject to modifications from time to time by the authorities of the university.

2. Minimum qualification for admission

A Pass in the following examinations

a) B. Pharm Degree examination of an Indian university established by law in India from an institution approved by Pharmacy Council of India and has scored not less than 55% of the maximum marks (aggregate of 4 years of B.Pharm.)

b) Every student, selected for admission to post graduate pharmacy program in any PCI approved institution should have obtained registration with the State Pharmacy Council or should obtain the same within one month from the date of his/her admission, failing which the admission of the candidate shall be cancelled.

Note: It is mandatory to submit a migration certificate obtained from the respective university where the candidate had passed his/her qualifying degree (B.Pharm.)

3. Duration of the program

The program of study for M.Pharm. shall extend over a period of four semesters (two academic years). The curricula and syllabi for the program shall be prescribed from time to time by Phamacy Council of India, New Delhi.

4. Medium of instruction and examinations

Medium of instruction and examination shall be in English.

5. Working days in each semester

Each semestershall consist of not less than 100 working days. The odd semesters shall be conducted from the month of June/July to November/December and the even semesters shall be conducted from the month of December/January to May/June in every calendar year.

6. Attendance and progress

A candidate is required to put in at least 80% attendance in individual courses considering theory and practical separately. The candidate shall complete the prescribed course satisfactorily to be eligible to appear for the respective examinations.

7. Program/Course credit structure

As per the philosophy of Credit Based Semester System, certain quantum of academic work viz. theory classes, practical classes, seminars, assignments, etc. are measured in terms of credits. On satisfactory completion of the courses, a candidate earns credits. The amount of credit associated with a course is dependent upon the number of hours of instruction per week in that course. Similarly the credit associated with any of the other academic, co/extra-curricular activities is dependent upon the quantum of work expected to be put in for each of these activities per week/per activity.

7.1. Credit assignment

7.1.1. Theory and Laboratory courses

Courses are broadly classified as Theory and Practical. Theory courses consist of lecture (L) and Practical (P) courses consist of hours spent in the laboratory. Credits (C) for a course is dependent on the number of hours of instruction per week in that course, and is obtained by using a multiplier of one (1) for lecture and a multiplier of half (1/2) for practical (laboratory) hours.Thus, for example, a theory course having four lectures per week throughout the semester carries a credit of 4. Similarly, a practical having four laboratory hours per week throughout semester carries a credit of 2.
The contact hours of seminars, assignments and research work shall be treated as that of practical courses for the purpose of calculating credits. i.e., the contact hours shall be multiplied by 1/2. Similarly, the contact hours of journal club, research work presentations and discussions with the supervisor shall be considered as theory course and multiplied by 1.

7.2. Minimum credit requirements

The minimum credit points required for the award of M. Pharm. degree is 95. However based on the credit points earned by the students under the head of co-curricular activities, a student shall earn a maximum of 100 credit points. These credits are divided into Theory courses, Practical, Seminars, Assignments, Research work, Discussions with the supervisor, Journal club and Co-Curricular activities over the duration of four semesters. The credits

are distributed semester-wise as shown in Table 9. Courses generally progress in sequence, building competencies and their positioning indicates certain academic maturity on the part of the learners. Learners are expected to follow the semester-wise schedule of courses given in the syllabus.

8. Academic work

A regular record of attendance both in Theory, Practical, Seminar, Assignment, Journal club, Discussion with the supervisor, Research work presentation and Dissertation shall be maintained by the department / teaching staff of respective courses.

9. Course of study

The specializations in M.Pharm program is given in Table 1.

Table – 1: List of M.Pharm. Specializations and their Code

S. No.	Specialization	Code
1.	Pharmaceutics	MPH
2.	Pharmaceutical Chemistry	MPC
3.	Pharmaceutical Regulatory Affairs	MRA
4.	Pharmacology	MPL
5.	Pharmacognosy	MPG

The course of study for M.Pharm specializations shall include Semester wise Theory & Practical as given in Table – 2. The number of hours to be devoted to each theory and practical course in any semester shall not be less than that shown in Table – 2 .

Table – 2: Course of study for M. Pharm. (Pharmaceutical Chemistry)

Course Code	Course	Credit Hours	Credit Points	Hrs./wk	Marks
Semester I					
MPC101T	Modern Pharmaceutical Analytical Techniques	4	4	4	100
MPC1012T	Advanced Organic Chemistry –I	4	4	4	100
MPC103T	Advanced Medicinal chemistry	4	4	4	100
MPC104T	Chemistry of Natural Products	4	4	4	100
MPC105P	Pharmaceutical Chemistry Practical I	12	6	12	150
-	Seminar/Assignment	7	4	7	100
	Total	35	26	35	650
Semester II					
MPC201T	Advanced Spectral Analysis	4	4	4	100
MPC202T	Advanced Organic Chemistry –II	4	4	4	100
MPC203T	Computer Aided Drug Design	4	4	4	100
MPC204T	Pharmaceutical Process Chemistry	4	4	4	100
MPC205P	Pharmaceutical Chemistry Practical II	12	6	12	150
-	Seminar/Assignment	7	4	7	100
	Total	35	26	35	650

Table – 3: Course of study for M. Pharm. III Semester
(Common for All Specializations)

Course Code	Course	Credit Hours	Credit Points
MRM 301T	Research Methodology and Biostatistics*	4	4
-	Journal club	1	1
-	Discussion / Presentation (Proposal Presentation)	2	2
-	Research Work	28	14
Total		35	21

* Non University Exam

Table – 4: Course of study for M. Pharm. IV Semester
(Common for All Specializations)

Course Code	Course	Credit Hours	Credit Points
-	Journal Club	1	1
-	Research Work	31	16
-	Discussion/Final Presentation	3	3
Total		35	20

Table – 5: Semester wise credits distribution

Semester	Credit Points
I	26
II	26
III	21
IV	20
Co-curricular Activities (Attending Conference, Scientific Presentations and Other Scholarly Activities)	Minimum=02 Maximum=07*
Total Credit Points	Minimum=95 Maximum=100*

*Credit Points for Co-curricular Activities

Table – 6: Guidelines for Awarding Credit Points for Co-curricular Activities

Name of the Activity	Maximum Credit Points Eligible / Activity
Participation in National Level Seminar/Conference/Workshop/Symposium/ Training Programs (related to the specialization of the student)	01
Participation in international Level Seminar/Conference/Workshop/Symposium/ Training Programs (related to the specialization of the student)	02
Academic Award/Research Award from State Level/National Agencies	01
Academic Award/Research Award from International Agencies	02
Research / Review Publication in National Journals (Indexed in Scopus / Web of Science)	01
Research / Review Publication in International Journals (Indexed in Scopus / Web of Science)	02

Note: International Conference: Held Outside India

International Journal: The Editorial Board Outside India

*The credit points assigned for extracurricular and or co-curricular activities shall be given by the Principals of the colleges and the same shall be submitted to the University. The criteria to acquire this credit point shall be defined by the colleges from time to time.

10. Program Committee

1. The M. Pharm. programme shall have a Programme Committee constituted by the Head of the institution in consultation with all the Heads of the departments.

2. The composition of the Programme Committee shall be as follows:

A teacher at the cadre of Professor shall be the Chairperson; One Teacher from eachM.Pharm specialization and four student representatives (two from each academic year), nominated by the Head of the institution.

3. Duties of the Programme Committee:

i. Periodically reviewing the progress of the classes.

ii. Discussing the problems concerning curriculum, syllabus and the conduct of classes.

iii. Discussing with the course teachers on the nature and scope of assessment for the course and the same shall be announced to the students at the beginning of respective semesters.

iv. Communicating its recommendation to the Head of the institution on academic matters.
v. The Programme Committee shall meet at least twice in a semester preferably at the end of each sessionalexam and before the end semester exam.

11. Examinations/Assessments

The schemes for internal assessment and end semester examinations are given in Table – 12.

11.1. End semester examinations

The End Semester Examinations for each theory and practical coursethrough semesters I to IVshall beconducted by the respective university except for the subject with asterix symbol (*) in table I and II for which examinations shall be conducted by the subject experts at college level and the marks/grades shall be submitted to the university.

Table 7 (Pharmaceutical Chemistry-MPC)

Course Code	Course	Internal Assessment				End Semester Exams		Total Marks
		Continuous Mode	Sessional Exams		Total	Marks	Duration	
			Marks	Duration				
SEMESTER I								
MPC101T	Modern Pharmaceutical Analytical Techniques	10	15	1 Hr	25	75	3 Hrs	100
MPC102T	Advanced Organic Chemistry -I	10	15	1 Hr	25	75	3 Hrs	100
MPC103T	Advanced Medicinal chemistry	10	15	1 Hr	25	75	3 Hrs	100
MPC104T	Chemistry of Natural Products	10	15	1 Hr	25	75	3 Hrs	100
MPC105P	Pharmaceutical Chemistry Practical I	20	30	6 Hrs	50	100	6 Hrs	150
-	Seminar /Assignment	-	-	-	-	-	-	100
Total								650
SEMESTER II								
MPC201T	Advanced Spectral Analysis	10	15	1 Hr	25	75	3 Hrs	100
MPC202T	Advanced Organic Chemistry -II	10	15	1 Hr	25	75	3 Hrs	100
MPC203T	Computer Aided Drug Design	10	15	1 Hr	25	75	3 Hrs	100
MPC204T	Pharmaceutical Process Chemistry	10	15	1 Hr	25	75	3 Hrs	100
MPC205P	Pharmaceutic	20	30	6 Hrs	50	100	6	150

	al Chemistry Practical II						Hrs	
-	Seminar /Assignment	-	-	-	-	-	-	100
Total								650

Tables – 8: Schemes for internal assessments and end semester examinations (Semester III& IV)

Course Code	Course	Internal Assessment				End Semester Exams		Total Marks
		Continuous Mode	Sessional Exams		Total	Marks	Duration	
			Marks	Duration				
SEMESTER III								
MRM301T	Research Methodology and Biostatistics*	10	15	1 Hr	25	75	3 Hrs	100
-	Journal club	-	-	-	25	-	-	25
-	Discussion / Presentation (Proposal Presentation)	-	-	-	50	-	-	50
-	Research work*	-	-	-	-	350	1 Hr	350
Total								525
SEMESTER IV								
-	Journal club	-	-	-	25	-	-	25
-	Discussion / Presentation (Proposal Presentation)	-	-	-	75	-	-	75
-	Research work and Colloquium	-	-	-	-	400	1 Hr	400
Total								500

*Non University Examination

11.2. Internal assessment: Continuous mode

The marks allocated for Continuous mode of Internal Assessment shall be awarded as per the scheme given below.

Table – 9: Scheme for awarding internal assessment: Continuous mode

Theory	
Criteria	Maximum Marks
Attendance (Refer Table – 28)	8
Student – Teacher interaction	2
Total	10
Practical	
Attendance (Refer Table – 28	10
Based on Practical Records, Regular viva voce, etc.	10
Total	20

Table – 10: Guidelines for the allotment of marks for attendance

Percentage of Attendance	Theory	Practical
95 – 100	8	10
90 – 94	6	7.5
85 – 89	4	5
80 – 84	2	2.5
Less than 80	0	0

11.2.1. Sessional Exams

Two sessional exams shall be conducted for each theory / practical course as per the schedule fixed by the college(s). The scheme of question paper for theory and practical sessional examinations is given in the table. The average marks of two sessional exams shall be computed for internal assessment as per the requirements given in tables.

12. Promotion and award of grades

A student shall be declared PASS and eligible for getting grade in a course of M.Pharm.programme if he/she secures at least 50% marks in that particular courseincluding internal assessment.

13. Carry forward of marks

In case a student fails to secure the minimum 50% in any Theory or Practical course as specified in 8, then he/she shall reappear for the end semester examination of that course. However his/her marks of the Internal Assessment shall be carried over and he/she shall be entitled for grade obtained by him/her on passing.

14. Improvement of internal assessment

A student shall have the opportunity to improve his/her performance only once in the sessional exam component of the internal assessment. The re-conduct of the sessional exam shall be completed before the commencement of next end semester theory examinations.

15. Reexamination of end semester examinations

Reexamination of end semester examination shall be conducted as per the schedule given in table 11. The exact dates of examinations shall be notified from time to time.

Table – 11: Tentative schedule of end semester examinations

Semester	For Regular Candidates	For Failed Candidates
I and III	November / December	May / June
II and IV	May / June	November / December

16. Allowed to keep terms (ATKT):

No student shall be admitted to any examination unless he/she fulfills the norms given in 6. ATKT rules are applicable as follows:

A student shall be eligible to carry forward all the courses of I and IIsemesters till the III semester examinations. However, he/she shall not be eligible to attend the courses of IV semester until all the courses of I, II and III semesters are successfully completed.

A student shall be eligible to get his/her CGPA upon successful completion of the courses of I to IV semesters within the stipulated time period as per the norms.

Note: Grade AB should be considered as failed and treated as one head for deciding ATKT. Such rules are also applicable for those students who fail to register for examination(s) of any course in any semester.

17. Grading of performances

17.1. Letter grades and grade points allocations:

Based on the performances, each student shall be awarded a final letter grade at the end of the semester for each course.The letter grades and their corresponding grade points are given in Table – 12.

Table – 12: Letter grades and grade points equivalent to Percentage of marks and performances

Percentage of Marks Obtained	Letter Grade	Grade Point	Performance
90.00 – 100	O	10	Outstanding
80.00 – 89.99	A	9	Excellent
70.00 – 79.99	B	8	Good
60.00 – 69.99	C	7	Fair
50.00 – 59.99	D	6	Average
Less than 50	F	0	Fail
Absent	AB	0	Fail

A learner who remains absent for any end semester examination shall be assigned a letter grade of AB and a corresponding grade point of zero. He/she should reappear for the said evaluation/examination in due course.

18. The Semester grade point average (SGPA)

The performance of a student in a semester is indicated by a number called 'Semester Grade Point Average' (SGPA). The SGPA is the weighted average of the grade points obtainedin all the courses by the student during the semester. For example, if a student takes five courses (Theory/Practical) in a semester with credits C1, C2, C3 and C4 and the student's grade points in these courses are G1, G2, G3 and G4, respectively, and then students' SGPA is equal to:

$$SGPA = \frac{C_1G_1 + C_2G_2 + C_3G_3 + C_4G_4}{C_1 + C_2 + C_3 + C_4}$$

The SGPA is calculated to two decimal points. It should be noted that, the SGPA for any semester shall take into consideration the F and ABS grade awarded in that semester. For example if a learner has a F or ABS grade in course 4, theSGPA shall then be computed as:

$$SGPA = \frac{C_1G_1 + C_2G_2 + C_3G_3 + C_4 * ZERO}{C_1 + C_2 + C_3 + C_4}$$

19. Cumulative Grade Point Average (CGPA)

The CGPA is calculated with the SGPA of all the IV semesters to two decimal points and is indicated in final grade report card/final transcript showing the grades of all IV semesters and their courses. The CGPA shall reflect the failed statusin case of F grade(s), tillthe course(s) is/are passed. When the course(s) is/are passedby obtaining a pass grade on subsequent examination(s) theCGPA

shall only reflect the new grade and not the fail grades earned earlier. The CGPA is calculated as:

$$CGPA = \frac{C_1S_1 + C_2S_2 + C_3S_3 + C_4S_4}{C_1 + C_2 + C_3 + C_4}$$

where C_1, C_2, C_3,.... is the total number of credits for semester I,II,III,.... and S_1,S_2, S_3,....is the SGPA of semester I,II,III,.... .

20. Declaration of class

The class shall be awarded on the basis of CGPA as follows:

First Class with Distinction = CGPA of. 7.50 and above
First Class = CGPA of 6.00 to 7.49
Second Class = CGPA of 5.00 to 5.99

21. Project work

All the students shall undertake a project under the supervision of a teacher in Semester III to IV and submit a report. 4 copies of the project report shall be submitted (typed & bound copy not less than 75 pages).

The internal and external examiner appointed by the University shall evaluate the project at the time of the Practical examinations of other semester(s). The projects shall be evaluated as per the criteria given below.

Evaluation of Dissertation Book:

Objective(s) of the work done	50 Marks
Methodology adopted	150 Marks
Results and Discussions	250 Marks
Conclusions and Outcomes	50 Marks
Total	500 Marks

Evaluation of Presentation:

Presentation of work	100 Marks
Communication skills	50 Marks
Question and answer skills	100 Marks
Total	250 Marks

22. Award of Ranks

Ranks and Medals shall be awarded on the basis of final CGPA. However, candidates who fail in one or more courses during the M.Pharm program shall not be eligible for award of ranks. Moreover, the candidates should have completed the M. Pharm program in minimum prescribed number of years, (two years) for the award of Ranks.

23. Award of degree

Candidates who fulfill the requirements mentioned above shall be eligible for award of degree during the ensuing convocation.

24. Duration for completion of the program of study

The duration for the completion of the program shall be fixed as double the actual duration of the program and the students have to pass within the said period, otherwise they have to get fresh Registration.

25. Revaluation I Retotaling of answer papers

There is no provision for revaluation of the answer papers in any examination. However, the candidates can apply for retotaling by paying prescribed fee.

26. Re-admission after break of study

Candidate who seeks re-admission to the program after break of study has to get the approval from the university by paying a condonation fee.

PHARMACEUTICALCHEMISTRY(MPC)

MODERN PHARMACEUTICAL ANALYTICAL TECHNIQUES

(MPC 101T)

Scope

This subject deals with various advanced analytical instrumental techniques for identification, characterization and quantification of drugs. Instruments dealt are NMR, Mass spectrometer, IR, HPLC, GC etc.

Objectives

After completion of course student is able to know about chemicals and excipients

- The analysis of various drugs in single and combination dosage forms
- Theoretical and practical skills of the instruments

THEORY 60 Hrs

1. a. UV-Visible spectroscopy: Introduction, Theory, Laws, Instrumentation associated with UV-Visible spectroscopy, Choice of solvents and solvent effect and Applications of UV-Visible spectroscopy, Difference/ Derivative spectroscopy. 10 Hrs

   b. IR spectroscopy: Theory, Modes of Molecular vibrations, Sample handling, Instrumentation of Dispersive and Fourier – Transform IR Spectrometer, Factors affecting vibrational frequencies and Applications of IR spectroscopy, Data Interpretation.

   c. Spectroflourimetry: Theory of Fluorescence, Factors affecting fluorescence (Characterestics of drugs that can be analysed by flourimetry), Quenchers, Instrumentation and Applications of fluorescence spectrophotometer.

   d. Flame emission spectroscopy and Atomic absorption spectroscopy: Principle, Instrumentation, Interferences and Applications.

2 NMR spectroscopy: Quantum numbers and their role in NMR, Principle, Instrumentation, Solvent requirement in NMR, Relaxation process, NMR signals in various compounds, Chemical shift, Factors influencing chemical shift, Spin-Spin coupling, Coupling constant, Nuclear magnetic double resonance, Brief outline of principles of FT-NMR and 13C NMR. Applications of NMR spectroscopy. 10 Hrs

3	Mass Spectroscopy: Principle, Theory, Instrumentation of Mass Spectroscopy, Different types of ionization like electron impact, chemical, field, FAB and MALDI, APCI, ESI, APPI Analyzers of Quadrupole and Time of Flight, Mass fragmentation and its rules, Meta stable ions, Isotopic peaks and Applications of Mass spectroscopy.	10 Hrs
4	Chromatography: Principle, apparatus, instrumentation, chromatographic parameters, factors affecting resolution, isolation of drug from excipients, data interpretation and applications of the following: a) Thin Layer chromatography b) High Performance Thin Layer Chromatography c) Ion exchange chromatography d) Column chromatography e) Gas chromatography f) High Performance Liquid chromatography g) Ultra High Performance Liquid chromatography h) Affinity chromatography i) Gel Chromatography	10 Hrs
5	a.Electrophoresis: Principle, Instrumentation, Working conditions, factors affecting separation and applications of the following: a) Paper electrophoresis b) Gel electrophoresis c) Capillary electrophoresis d) Zone electrophoresis e) Moving boundary electrophoresis f) Iso electric focusing b) X ray Crystallography: Production of X rays, Different X ray methods, Bragg's law, Rotating crystal technique, X ray powder technique, Types of crystals and applications of X-ray diffraction.	10 Hrs
6	a. Potentiometry: Principle, working, Ion selective Electrodes and Application of potentiometry. b. Thermal Techniques: Principle, thermal transitions and Instrumentation (Heat flux and power-compensation and designs), Modulated DSC, Hyper DSC, experimental parameters (sample preparation, experimental conditions, calibration, heating and cooling rates, resolution, source of errors) and their influence, advantage and disadvantages, pharmaceutical applications. Differential Thermal Analysis (DTA): Principle, instrumentation	10 Hrs

and advantage and disadvantages, pharmaceutical applications, derivative differential thermal analysis (DDTA). TGA: Principle, instrumentation, factors affecting results, advantage and disadvantages, pharmaceutical applications.

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ADVANCED ORGANIC CHEMISTRY - I
(MPC 102T)

Scope

The subject is designed to provide in-depth knowledge about advances in organic chemistry, different techniques of organic synthesis and their applications to process chemistry as well as drug discovery.

Objectives

Upon completion of course, the student shall be to understand

- The principles and applications of reterosynthesis
- The mechanism & applications of various named reactions
- The concept of disconnection to develop synthetic routes for small target molecule.
- The various catalysts used in organic reactions
- The chemistry of heterocyclic compounds

THEORY 60 Hrs

1. Basic Aspects of Organic Chemistry: 12 Hrs
   1. Organic intermediates: Carbocations, carbanions, free radicals, carbenes and nitrenes. Their method of formation, stability and synthetic applications.
   2. Types of reaction mechanisms and methods of determining them,
   3. Detailed knowledge regarding the reactions, mechanisms and their relative reactivity and orientations.

   Addition reactions

   a) Nucleophilic uni- and bimolecular reactions (SN1 and SN2)
   b) Elimination reactions (E1 & E2; Hoffman & Saytzeff's rule)
   c) Rearrangement reaction

2 Study of mechanism and synthetic applications of following named Reactions: 12 Hrs

Ugi reaction, Brook rearrangement, Ullmann coupling reactions, Dieckmann Reaction, Doebner-Miller Reaction, Sandmeyer Reaction, Mitsunobu reaction, Mannich reaction, Vilsmeyer-Haack Reaction, Sharpless asymmetric epoxidation, Baeyer-Villiger oxidation, Shapiro & Suzuki reaction, Ozonolysis and Michael addition reaction

3 Synthetic Reagents & Applications: 12 Hrs

Aluminiumisopropoxide, N-bromosuccinamide, diazomethane, dicyclohexylcarbodimide, Wilkinson reagent, Witting reagent. Osmium tetroxide, titanium chloride, diazopropane, diethyl azodicarboxylate, Triphenylphosphine, Benzotriazol-1-yloxy) tris (dimethylamino) phosphonium hexafluoro-phosphate (BOP).

Protecting groups

a. Role of protection in organic synthesis
b. Protection for the hydroxyl group, including 1,2-and1,3-diols: ethers, esters, carbonates, cyclic acetals & ketals
c. Protection for the Carbonyl Group: Acetals and Ketals
d. Protection for the Carboxyl Group: amides and hydrazides, esters
e. Protection for the Amino Group and Amino acids: carbamates and amides

4 Heterocyclic Chemistry: 12 Hrs

Organic Name reactions with their respective mechanism and application involved in synthesis of drugs containing five, six membered and fused hetrocyclics such as Debus-Radziszewski imidazole synthesis, Knorr Pyrazole Synthesis Pinner Pyrimidine Synthesis, Combes Quinoline Synthesis, Bernthsen Acridine Synthesis, Smiles rearrangement and Traube purine synthesis.

Synthesis of few representative drugs containing these hetrocyclic nucleus such as Ketoconazole, Metronidazole, Miconazole, celecoxib, antipyrin, Metamizole sodium, Terconazole, Alprazolam, Triamterene, Sulfamerazine, Trimethoprim, Hydroxychloroquine, Quinine, Chloroquine, Quinacrine, Amsacrine, Prochlorpherazine, Promazine, Chlorpromazine,Theophylline , Mercaptopurine and Thioguanine.

5 Synthon approach and retrosynthesis applications 12 Hrs

i. Basic principles, terminologies and advantages of retrosynthesis; guidelines for dissection of molecules. Functional group interconvertion and addition (FGI and FGA)
ii. C-X disconnections; C-C disconnections – alcohols and carbonyl compounds; 1,2-, 1,3-,1,4-, 1,5-, 1,6-difunctionalized compounds
iii. Strategies for synthesis of three, four, five and six-membered ring.

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1. "Advanced Organic chemistry, Reaction, Mechanisms and Structure", J March, John Wiley and Sons, New York.
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3. "Organic Chemistry" Clayden, Greeves, Warren and Woihers., Oxford University Press 2001.
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10. Principles of Organic Synthesis, ROC Norman and JM Coxan, Nelson Thorns.
11. Organic Synthesis – Special Techniques. VK Ahluwalia and R Agarwal, Narosa Publishers.
12. Organic Reaction Mechanisms IVth Edtn, VK Ahluwalia and RK Parashar, Narosa Publishers.

ADVANCED MEDICINAL CHEMISTRY
(MPC 103T)

Scope

The subject is designed to impart knowledge about recent advances in the field of medicinal chemistry at the molecular level including different techniques for the rational drug design.

Objectives

At completion of this course it is expected that students will be able to understand

- Different stages of drug discovery
- Role of medicinal chemistry in drug research
- Different techniques for drug discovery
- Various strategies to design and develop new drug like molecules for biological targets
- Peptidomimetics

THEORY 60 Hrs

1. Drug discovery: Stages of drug discovery, lead discovery; identification, validation and diversity of drug targets. 12 Hrs

   Biological drug targets: Receptors, types, binding and activation, theories of drug receptor interaction, drug receptor interactions, agonists vs antagonists, artificial enzymes.

2 Prodrug Design and Analog design: 12 Hrs

   a) Prodrug design: Basic concept, Carrier linked prodrugs / Bioprecursors, Prodrugs of functional group, Prodrugs to improve patient acceptability, Drug solubility, Drug absorption and distribution, site specific drug delivery and sustained drug action. Rationale of prodrug design and practical consideration of prodrug design.

   b) Combating drug resistance: Causes for drug resistance, strategies to combat drug resistance in antibiotics and anticancer therapy, Genetic principles of drug resistance.

   c) Analog Design: Introduction, Classical & Non classical, Bioisosteric replacement strategies, rigid analogs,

alteration of chain branching, changes in ring size, ring position isomers, design of stereo isomers and geometric isomers, fragments of a lead molecule, variation in inter atomic distance.

3 a) Medicinal chemistry aspects of the following class of drugs — 12 Hrs

Systematic study, SAR, Mechanism of action and synthesis of new generation molecules of following class of drugs:

a) Anti-hypertensive drugs, Psychoactive drugs, Anticonvulsant drugs, H1 & H2 receptor antagonist, COX1 & COX2 inhibitors, Adrenergic & Cholinergic agents, Antineoplastic and Antiviral agents.

b) Stereochemistry and Drug action: Realization that stereo selectivity is a pre-requisite for evolution. Role of chirality in selective and specific therapeutic agents. Case studies, Enantio selectivity in drug adsorption, metabolism, distribution and elimination.

4 Rational Design of Enzyme Inhibitors — 12 Hrs

Enzyme kinetics & Principles of Enzyme inhibitors, Enzyme inhibitors in medicine, Enzyme inhibitors in basic research, rational design of non-covalently and covalently binding enzyme inhibitors.

5 Peptidomimetics — 12 Hrs

Therapeutic values of Peptidomimetics, design of peptidomimetics by manipulation of the amino acids, modification of the peptide backbone, incorporating conformational constraints locally or globally. Chemistry of prostaglandins, leukotrienes and thromboxones.

REFERENCES

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10. An Introduction to Medicinal Chemistry, Graham L.Patrick, III Edition, Oxford University Press, USA.
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CHEMISTRY OF NATURAL PRODUCTS
(MPC 104T)

Scope

The subject is designed to provide detail knowledge about chemistry of medicinal compounds from natural origin and general methods of structural elucidation of such compounds. It also emphasizes on isolation, purification and characterization of medicinal compounds from natural origin.

Objectives

At completion of this course it is expected that students will be able to understand–

- Different types of natural compounds and their chemistry and medicinal importance
- The importance of natural compounds as lead molecules for new drug discovery
- The concept of rDNA technology tool for new drug discovery
- General methods of structural elucidation of compounds of natural origin
- Isolation, purification and characterization of simple chemical constituents from natural source

THEORY — 60 Hrs

1. Study of Natural products as leads for new pharmaceuticals for the following class of drugs — 12 Hrs
   a) Drugs Affecting the Central Nervous System: Morphine Alkaloids
   b) Anticancer Drugs: Paclitaxel and Docetaxel, Etoposide, and Teniposide
   c) Cardiovascular Drugs: Lovastatin, Teprotide and Dicoumarol
   d) Neuromuscular Blocking Drugs: Curare alkaloids
   e) Anti-malarial drugs and Analogues
   f) Chemistry of macrolid antibiotics (Erythromycin, Azithromycin, Roxithromycin, and Clarithromycin) and β – Lactam antibiotics (Cephalosporins and Carbapenem)
2. a) Alkaloids — 12 Hrs

   General introduction, classification, isolation, purification, molecular modification and biological activity of alkaloids, general methods of structural determination of alkaloids, structural elucidation and stereochemistry of ephedrine, morphine, ergot, emetine and reserpine.

b) Flavonoids

Introduction, isolation and purification of flavonoids, General methods of structural determination of flavonoids; Structural elucidation of quercetin.

c) Steroids

General introduction, chemistry of sterols, sapogenin and cardiac glycosides. Stereochemistry and nomenclature of steroids, chemistry of contraceptive agents male & female sex hormones (Testosterone, Estradiol, Progesterone), adrenocorticoids (Cortisone), contraceptive agents and steroids (Vit – D).

3 a) Terpenoids 12 Hrs

Classification, isolation, isoprene rule and general methods of structural elucidation of Terpenoids; Structural elucidation of drugs belonging to mono (citral, menthol, camphor), di(retinol, Phytol, taxol) and tri terpenoids (Squalene,Ginsenoside) carotinoids (β carotene).

b) Vitamins

Chemistry and Physiological significance of Vitamin A, B1, B2, B12, C, E, Folic acid and Niacin.

4 a). Recombinant DNA technology and drug discovery 12 Hrs

rDNA technology, hybridoma technology, New pharmaceuticals derived from biotechnology; Oligonucleotide therapy. Gene therapy: Introduction, Clinical application and recent advances in gene therapy, principles of RNA & DNA estimation

b). Active constituent of certain crude drugs used in Indigenous system Diabetic therapy – Gymnema sylvestre, Salacia reticulate, Pterocarpus marsupiam, Swertia chirata, Trigonella foenum graccum; Liver dysfunction – Phyllanthus niruri; Antitumor – Curcuma longa Linn.

5 Structural Characterization of natural compounds 12 Hrs

Structural characterization of natural compounds using IR, 1HNMR, 13CNMR and MS Spectroscopy of specific drugs e.g., Penicillin, Morphine, Camphor, Vit-D, Quercetin and Digitalis glycosides.

REFERENCES

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PHARMACEUTICAL CHEMISTRY PRACTICAL - I
(MPC 105P)

1. Analysis of Pharmacopoeial compounds and their formulations by UV Vis spectrophotometer, RNA & DNA estimation
2. Simultaneous estimation of multi component containing formulations by UV spectrophotometry
3. Experiments based on Column chromatography
4. Experiments based on HPLC
5. Experiments based on Gas Chromatography
6. Estimation of riboflavin/quinine sulphate by fluorimetry
7. Estimation of sodium/potassium by flame photometry

To perform the following reactions of synthetic importance

1. Purification of organic solvents, column chromatography
2. Claisen-schimidt reaction.
3. Benzyllic acid rearrangement.
4. Beckmann rearrangement.
5. Hoffmann rearrangement
6. Mannich reaction
7. Synthesis of medicinally important compounds involving more than one step along with purification and Characterization using TLC, melting point and IR spectroscopy (4 experiments)
8. Estimation of elements and functional groups in organic natural compounds
9. Isolation, characterization like melting point, mixed melting point, molecular weight determination, functional group analysis, co-chromatographic technique for identification of isolated compounds and interpretation of UV and IR data.
10. Some typical degradation reactions to be carried on selected plant constituents

ADVANCED SPECTRAL ANALYSIS
(MPC 201T)

Scope

This subject deals with various hyphenated analytical instrumental techniques for identification, characterization and quantification of drugs. Instruments dealt are LC-MS, GC-MS, ATR-IR, DSC etc.

Objectives

At completion of this course it is expected that students will be able to understand-

- Interpretation of the NMR, Mass and IR spectra of various organic compounds
- Theoretical and practical skills of the hyphenated instruments
- Identification of organic compounds

	THEORY	60Hrs
1.	UV and IR spectroscopy: Wood ward – Fieser rule for 1,3- butadienes, cyclic dienes and α, β-carbonyl compounds and interpretation compounds of enones. ATR-IR, IR Interpretation of organic compounds.	12 Hrs
2	NMR spectroscopy: 1-D and 2-D NMR, NOESY and COSY, HECTOR, INADEQUATE techniques, Interpretation of organic compounds.	12 Hrs
3	Mass Spectroscopy Mass fragmentation and its rules, Fragmentation of important functional groups like alcohols, amines, carbonyl groups and alkanes, Meta stable ions, Mc Lafferty rearrangement, Ring rule, Isotopic peaks, Interpretation of organic compounds.	12 Hrs
4	Chromatography: Principle, Instrumentation and Applications of the following : a) GC-MS b) GC-AAS c) LC-MS d) LC-FTIR e) LC-NMR f) CE-MS g) High Performance Thin Layer chromatography h) Super critical fluid chromatography i) Ion Chromatography j) I-EC (Ion-Exclusion Chromatography) k) Flash chromatography	12 Hrs

5 a). Thermal methods of analysis 12 Hrs

Introduction, principle, instrumentation and application of DSC, DTA and TGA.

b). Raman Spectroscopy

Introduction, Principle, Instrumentation and Applications.

c). Radio immuno assay

Biological standardization , bioassay, ELISA, Radioimmuno assay of digitalis and insulin.

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ADVANCED ORGANIC CHEMISTRY - II
(MPC 202T)

Scope

The subject is designed to provide in-depth knowledge about advances in organic chemistry, different techniques of organic synthesis and their applications to process chemistry as well as drug discovery.

Objectives

Upon completion of course, the student shall able to understand

- The principles and applications of Green chemistry
- The concept of peptide chemistry.
- The various catalysts used in organic reactions
- The concept of stereochemistry and asymmetric synthesis.

THEORY — **60 Hrs**

1. **Green Chemistry:** — **12 Hrs**
   a. Introduction, principles of green chemistry
   b. Microwave assisted reactions: Merit and demerits of its use, increased reaction rates, mechanism, superheating effects of microwave, effects of solvents in microwave assisted synthesis, microwave technology in process optimization, its applications in various organic reactions and heterocycles synthesis
   c. Ultrasound assisted reactions: Types of sonochemical reactions, homogenous, heterogeneous liquid-liquid and liquid-solid reactions, synthetic applications
   d. Continuous flow reactors: Working principle, advantages and synthetic applications.
2. **Chemistry of peptides** — **12 Hrs**
   a. Coupling reactions in peptide synthesis
   b. Principles of solid phase peptide synthesis, t-BOC and FMOC protocols, various solid supports and linkers: Activation procedures, peptide bond formation, deprotection and cleavage from resin, low and high HF cleavage protocols, formation of free peptides and peptide amides, purification and case studies, site-specific chemical modifications of peptides
   c. Segment and sequential strategies for solution phase peptide synthesis with any two case studies
   d. Side reactions in peptide synthesis: Deletion peptides, side

reactions initiated by proton abstraction, protonation, over-activation and side reactions of individual amino acids.

3 Photochemical Reactions — 12 Hrs

Basic principles of photochemical reactions. Photo-oxidation, photo-addition and photo-fragmentation.

Pericyclic reactions

Mechanism, Types of pericyclic reactions such as cyclo addition, electrocyclic reaction and sigmatrophic rearrangement reactions with examples

4 Catalysis: — 12 Hrs

a. Types of catalysis, heterogeneous and homogenous catalysis, advantages and disadvantages
b. Heterogeneous catalysis – preparation, characterization, kinetics, supported catalysts, catalyst deactivation and regeneration, some examples of heterogeneous catalysis used in synthesis of drugs.
c. Homogenous catalysis, hydrogenation, hydroformylation, hydrocyanation, Wilkinson catalysts, chiral ligands and chiral induction, Ziegler-Natta catalysts, some examples of homogenous catalysis used in synthesis of drugs
d. Transition-metal and Organo-catalysis in organic synthesis: Metal-catalyzed reactions
e. Biocatalysis: Use of enzymes in organic synthesis, immobilized enzymes/cells in organic reaction.
f. Phase transfer catalysis - theory and applications

5 Stereochemistry & Asymmetric Synthesis — 12 Hrs

a. Basic concepts in stereochemistry – optical activity, specific rotation, racemates and resolution of racemates, the Cahn, Ingold, Prelog (CIP) sequence rule, meso compounds, pseudo asymmetric centres, axes of symmetry, Fischers D and L notation, cis-trans isomerism, E and Z notation.
b. Methods of asymmetric synthesis using chiral pool, chiral auxiliaries and catalytic asymmetric synthesis, enantiopure separation and Stereo selective synthesis with examples.

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2. "Mechanism and structure in organic chemistry", ES Gould, Hold Rinchart and Winston,NewYork.
3. "Organic Chemistry" Clayden, Greeves, Warren and Woihers., Oxford University Press 2001.
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8. Organic synthesis- Special techniques VK Ahluwalia and R Aggarwal, Narosa Publishers.
9. Organic reaction mechanisms IV edtn, VK Ahluwalia and RK Parashar, Narosa Publishers.

COMPUTER AIDED DRUG DESIGN
(MPC 203T)

Scope

The subject is designed to impart knowledge on the current state of the art techniques involved in computer assisted drug design.

Objectives

At completion of this course it is expected that students will be able to understand

- Role of CADD in drug discovery
- Different CADD techniques and their applications
- Various strategies to design and develop new drug like molecules.
- Working with molecular modeling softwares to design new drug molecules
- The in silico virtual screening protocols

Theory 60 Hrs

1. Introduction to Computer Aided Drug Design(CADD) 12 Hrs

History, different techniques and applications.
Quantitative Structure Activity Relationships: Basics

History and development of QSAR: Physicochemical parameters and methods to calculate physicochemical parameters: Hammett equation and electronic parameters (sigma), lipophilicity effects and parameters (log P, pi-substituent constant), steric effects (Taft steric and MR parameters) Experimental and theoretical approaches for the determination of these physicochemical parameters.

2 Quantitative Structure Activity Relationships: Applications 12 Hrs

Hansch analysis, Free Wilson analysis and relationship between them, Advantages and disadvantages; Deriving 2D-QSAR equations.
3D-QSAR approaches and contour map analysis.
Statistical methods used in QSAR analysis and importance of statistical parameters.

3 Molecular Modeling and Docking 12 Hrs

a) Molecular and Quantum Mechanics in drug design.
b) Energy Minimization Methods: comparison between global

minimum conformation and bioactive conformation

c) Molecular docking and drug receptor interactions: Rigid docking, flexible docking and extra-precision docking. Agents acting on enzymes such as DHFR, HMG-CoA reductase and HIV protease, choline esterase (AchE & BchE)

4 Molecular Properties and Drug Design — 12 Hrs

a) Prediction and analysis of ADMET properties of new molecules and its importance in drug design.

b) De novo drug design: Receptor/enzyme-interaction and its analysis, Receptor/enzyme cavity size prediction, predicting the functional components of cavities, Fragment based drug design.

c) Homology modeling and generation of 3D-structure of protein.

5 Pharmacophore Mapping and Virtual Screening — 12 Hrs

Concept of pharmacophore, pharmacophore mapping, identification of Pharmacophore features and Pharmacophore modeling; Conformational search used in pharmacophore mapping.

In Silico Drug Design and Virtual Screening Techniques

Similarity based methods and Pharmacophore based screening, structure based In-silico virtual screening protocols.

REFERENCES

1. Computational and structural approaches to drug discovery, Robert M Stroud and Janet. F Moore, RCS Publishers.
2. Introduction to Quantitative Drug Design by Y.C. Martin, CRC Press, Taylor & Francis group..
3. Drug Design by Ariens Volume 1 to 10, Academic Press, 1975, Elsevier Publishers.
4. Principles of Drug Design by Smith and Williams, CRC Press, Taylor & Francis.
5. The Organic Chemistry of the Drug Design and Drug action by Richard B. Silverman, Elsevier Publishers.
6. Medicinal Chemistry by Burger, Wiley Publishing Co.

7. An Introduction to Medicinal Chemistry –Graham L. Patrick, Oxford University Press.
8. Wilson and Gisvold's Text book of Organic Medicinal and Pharmaceutical Chemistry, Ippincott Williams & Wilkins.
9. Comprehensive Medicinal Chemistry – Corwin and Hansch, Pergamon Publishers.
10. Computational and structural approaches to drug design edited by Robert M Stroud and Janet. F Moore

PHARMACEUTICAL PROCESS CHEMISTRY
(MPC 204T)

Scope

Process chemistry is often described as scale up reactions, taking them from small quantities created in the research lab to the larger quantities that are needed for further testing and then to even larger quantities required for commercial production. The goal of a process chemist is to develop synthetic routes that are safe, cost-effective, environmentally friendly, and efficient. The subject is designed to impart knowledge on the development and optimization of a synthetic route/s and the pilot plant procedure for the manufacture of Active Pharmaceutical Ingredients (APIs) and new chemical entities (NCEs) for the drug development phase.

Objectives

At completion of this course it is expected that students will be able to understand

- The strategies of scale up process of apis and intermediates
- The various unit operations and various reactions in process chemistry

THEORY 60 Hrs

1. Process chemistry 12 Hrs

Introduction, Synthetic strategy

Stages of scale up process: Bench, pilot and large scale process.

In-process control and validation of large scale process.

Case studies of some scale up process of APIs.

Impurities in API, types and their sources including genotoxic impurities

2 Unit operations 12 Hrs

a) Extraction: Liquid equilibria, extraction with reflux, extraction with agitation, counter current extraction.
b) Filtration: Theory of filtration, pressure and vacuum filtration, centrifugal filtration,
c) Distillation: azeotropic and steam distillation
d) Evaporation: Types of evaporators, factors affecting evaporation.
e) Crystallization: Crystallization from aqueous, non-aqueous solutions factors affecting crystallization, nucleation. Principle and general methods of Preparation of polymorphs, hydrates, solvates and amorphous APIs.

3	Unit Processes - I	12 Hrs

a) Nitration: Nitrating agents, Aromatic nitration, kinetics and mechanism of aromatic nitration, process equipment for technical nitration, mixed acid for nitration,

b) Halogenation: Kinetics of halogenations, types of halogenations, catalytic halogenations. Case study on industrial halogenation process.

c) Oxidation: Introduction, types of oxidative reactions, Liquid phase oxidation with oxidizing agents. Nonmetallic Oxidizing agents such as H_2O_2, sodium hypochlorite, Oxygen gas, ozonolysis.

4	Unit Processes - II	12 Hrs

a) Reduction: Catalytic hydrogenation, Heterogeneous and homogeneous catalyst; Hydrogen transfer reactions, Metal hydrides. Case study on industrial reduction process.

b) Fermentation: Aerobic and anaerobic fermentation. Production of
   i. Antibiotics; Penicillin and Streptomycin,
   ii. Vitamins: B2 and B12
   iii. Statins: Lovastatin, Simvastatin

c) Reaction progress kinetic analysis
   i. Streamlining reaction steps, route selection,
   ii. Characteristics of expedient routes, characteristics of cost-effective routes, reagent selection, families of reagents useful for scale-up.

5	Industrial Safety	12 Hrs

a) MSDS (Material Safety Data Sheet), hazard labels of chemicals and Personal Protection Equipment (PPE)

b) Fire hazards, types of fire & fire extinguishers

c) Occupational Health & Safety Assessment Series 1800 (OHSAS-1800) and ISO-14001(Environmental Management System), Effluents and its management

REFERENCES

1. Process Chemistry in the Pharmaceutical Industry: Challenges in an Ever-Changing Climate-An Overview; K. Gadamasetti, CRC Press.
2. Pharmaceutical Manufacturing Encyclopedia, 3rd edition, Volume 2.
3. Medicinal Chemistry by Burger, 6th edition, Volume 1-8.
4. W.L. McCabe, J.C Smith, Peter Harriott. Unit operations of chemical engineering, 7th edition, McGraw Hill
5. Polymorphism in Pharmaceutical Solids .Dekker Series Volume 95 Ed: H G Brittain (1999)
6. Regina M. Murphy: Introduction to Chemical Processes: Principles, Analysis, Synthesis
7. Peter J. Harrington: Pharmaceutical Process Chemistry for Synthesis: Rethinking the Routes to Scale-Up
8. P.H.Groggins: Unit processes in organic synthesis (MGH)
9. F.A.Henglein: Chemical Technology (Pergamon)
10. M.Gopal: Dryden's Outlines of Chemical Technology, WEP East-West Press
11. Clausen,Mattson: Principle of Industrial Chemistry, Wiley Publishing Co.,
12. Lowenheim & M.K. Moran: Industrial Chemicals
13. S.D. Shukla & G.N. Pandey: A text book of Chemical Technology Vol. II, Vikas Publishing House
14. J.K. Stille: Industrial Organic Chemistry (PH)
15. Shreve: Chemical Process, McGrawhill.
16. B.K.Sharma: Industrial Chemistry, Goel Publishing House
17. ICH Guidelines
18. United States Food and Drug Administration official website www.fda.gov

PHARMACEUTICAL CHEMISTRY PRACTICALS – II

(MPC 205P)

1. Synthesis of organic compounds by adapting different approaches involving (3 experiments)
   a) Oxidation
   b) Reduction/hydrogenation
   c) Nitration
2. Comparative study of synthesis of APIs/intermediates by different synthetic routes (2 experiments)
3. Assignments on regulatory requirements in API (2 experiments)
4. Comparison of absorption spectra by UV and Wood ward – Fieser rule
5. Interpretation of organic compounds by FT-IR
6. Interpretation of organic compounds by NMR
7. Interpretation of organic compounds by MS
8. Determination of purity by DSC in pharmaceuticals
9. Identification of organic compounds using FT-IR, NMR, CNMR and Mass spectra
10. To carry out the preparation of following organic compounds
11. Preparation of 4-chlorobenzhydrylpiperazine. (an intermediate for cetirizine HCl).
12. Preparation of 4-iodotolene from p-toluidine.
13. $NaBH_4$ reduction of vanillin to vanillyl alcohol
14. Preparation of umbelliferone by Pechhman reaction
15. Preparation of triphenyl imidazole
16. To perform the Microwave irradiated reactions of synthetic importance (Any two)
17. Determination of log P, MR, hydrogen bond donors and acceptors of selected drugs using softwares
18. Calculation of ADMET properties of drug molecules and its analysis using softwares
    Pharmacophore modeling
19. 2D-QSAR based experiments
20. 3D-QSAR based experiments
21. Docking study based experiment
22. Virtual screening based experiment

Semester III

MRM 301T - Research Methodology & Biostatistics

UNIT – I

General Research Methodology: Research, objective, requirements, practical difficulties, review of literature, study design, types of studies, strategies to eliminate errors/bias, controls, randomization, crossover design, placebo, blinding techniques.

UNIT – II

Biostatistics: Definition, application, sample size, importance of sample size, factors influencing sample size, dropouts, statistical tests of significance, type of significance tests, parametric tests(students "t" test, ANOVA, Correlation coefficient, regression), non-parametric tests (wilcoxan rank tests, analysis of variance, correlation, chi square test), null hypothesis, P values, degree of freedom, interpretation of P values.

UNIT – III

Medical Research: History, values in medical ethics, autonomy, beneficence, non-maleficence, double effect, conflicts between autonomy and beneficence/non-maleficence, euthanasia, informed consent, confidentiality, criticisms of orthodox medical ethics, importance of communication, control resolution, guidelines, ethics committees, cultural concerns, truth telling, online business practices, conflicts of interest, referral, vendor relationships, treatment of family members, sexual relationships, fatality.

UNIT – IV

CPCSEA guidelines for laboratory animal facility: Goals, veterinary care, quarantine, surveillance, diagnosis, treatment and control of disease, personal hygiene, location of animal facilities to laboratories, anesthesia, euthanasia, physical facilities, environment, animal husbandry, record keeping, SOPs, personnel and training, transport of lab animals.

UNIT – V

Declaration of Helsinki: History, introduction, basic principles for all medical research, and additional principles for medical research combined with medical care.

Pharmacy Council of India

New Delhi

Rules & Syllabus for the Bachelor of Pharmacy (B. Pharm) Course

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[Framed under Regulation 6, 7 & 8 of the Bachelor of Pharmacy (B. Pharm) course regulations 2014]

CHAPTER- I: REGULATIONS

1. Short Title and Commencement

These regulations shall be called as "The Revised Regulations for the B. Pharm. Degree Program (CBCS)of the Pharmacy Council of India, New Delhi". They shall come into effect from the Academic Year 2016-17. The regulations framed are subject to modifications from time to time by Pharmacy Council of India.

2. Minimum qualification for admission

2.1 First year B. Pharm:

Candidate shall have passed 10+2 examination conducted by the respective state/central government authorities recognized as equivalent to 10+2 examination by the Association of Indian Universities (AIU) with English as one of the subjects and Physics, Chemistry, Mathematics (P.C.M) and or Biology (P.C.B / P.C.M.B.) as optional subjects individually. Any other qualification approved by the Pharmacy Council of India as equivalent to any of the above examinations.

2.2. B. Pharm lateral entry (to third semester):

A pass in D. Pharm. course from an institution approved by the Pharmacy Council of India under section 12 of the Pharmacy Act.

3. Duration of the program

The course of study for B.Pharm shall extend over a period of eight semesters (four academic years) and six semesters (three academic years) for lateral entry students. The curricula and syllabi for the program shall be prescribed from time to time by Pharmacy Council of India, New Delhi.

4. Medium of instruction and examinations

Medium of instruction and examination shall be in English.

5. Working days in each semester

Each semestershall consist of not less than 100 working days. The odd semesters shall be conducted from the month of June/July to November/December and the even semesters shall be conducted from December/January to May/June in every calendar year.

6. Attendance and progress

A candidate is required to put in at least 80% attendance in individual courses considering theory and practical separately. The candidate shall complete the prescribed course satisfactorily to be eligible to appear for the respective examinations.

7. Program/Course credit structure

As per the philosophy of Credit Based Semester System, certain quantum of academic work viz. theory classes, tutorial hours, practical classes, etc. are measured in terms of credits. On satisfactory completion of the courses, a candidate earns credits. The amount of credit associated with a course is dependent upon the number of hours of instruction per week in that course. Similarly, the credit associated with any of the other academic, co/extra-curricular activities is dependent upon the quantum of work expected to be put in for each of these activities per week.

7.1. Credit assignment

7.1.1. Theory and Laboratory courses

Courses are broadly classified as Theory and Practical. Theory courses consist of lecture (L) and /or tutorial (T) hours, and Practical (P) courses consist of hours spent in the laboratory. Credits (C) for a course is dependent on the number of hours of instruction per week in that course, and is obtained by using a multiplier of one (1) for lecture and tutorial hours, and a multiplier of half (1/2) for practical (laboratory) hours. Thus, for example, a theory course having three lectures and one tutorial per week throughout the semester carries a credit of 4. Similarly, a practical having four laboratory hours per week throughout semester carries a credit of 2.

7.2. Minimum credit requirements

The minimum credit points required for award of a B. Pharm. degree is 208. These credits are divided into Theory courses, Tutorials, Practical, Practice School and Projectover the duration of eight semesters. The credits are distributed semester-wise as shown in Table IX. Courses generally progress in sequences, building competencies and their positioning indicates certain academic maturity on the part of the learners. Learners are expected to follow the semester-wise schedule of courses given in the syllabus.

The lateral entry students shall get 52 credit points transferred from their D. Pharm program. Such students shall take up additional remedial courses of 'Communication Skills' (Theory and Practical) and 'Computer Applications in Pharmacy' (Theory and Practical) equivalent to 3 and 4 credit points respectively, a total of 7 credit points to attain 59 credit points, the maximum of I and II semesters.

8. Academic work

A regular record of attendance both in Theory and Practical shall be maintained by the teaching staff of respective courses.

9. Course of study

The course of study for B. Pharm shall include Semester Wise Theory & Practical as given in Table – I to VIII. The number of hours to be devoted to each theory, tutorial and practical course in any semester shall not be less than that shown in Table – I to VIII.

Table-I: Course of study for semester I

Course code	Name of the course	No. of hours	Tutorial	Credit points
BP101T	Human Anatomy and Physiology I– Theory	3	1	4
BP102T	Pharmaceutical Analysis I – Theory	3	1	4
BP103T	Pharmaceutics I – Theory	3	1	4
BP104T	Pharmaceutical Inorganic Chemistry – Theory	3	1	4
BP105T	Communication skills – Theory *	2	-	2
BP106RBT BP106RMT	Remedial Biology/ Remedial Mathematics – Theory*	2	-	2
BP107P	Human Anatomy and Physiology – Practical	4	-	2
BP108P	Pharmaceutical Analysis I – Practical	4	-	2
BP109P	Pharmaceutics I – Practical	4	-	2
BP110P	Pharmaceutical Inorganic Chemistry – Practical	4	-	2
BP111P	Communication skills – Practical*	2	-	1
BP112RBP	Remedial Biology – Practical*	2	-	1
	Total	**32/34$/36#**	**4**	**27/29$/30#**

#Applicable ONLY for the students who have studied Mathematics / Physics / Chemistry at HSC and appearing for Remedial Biology (RB)course**.**

$Applicable ONLY for the students who have studied Physics / Chemistry / Botany / Zoology at HSC and appearing for Remedial Mathematics (RM)course**.**

* Non University Examination (NUE)

Table-II: Course of study for semester II

Course Code	Name of the course	No. of hours	Tutorial	Credit points
BP201T	Human Anatomy and Physiology II – Theory	3	1	4
BP202T	Pharmaceutical Organic Chemistry I – Theory	3	1	4
BP203T	Biochemistry – Theory	3	1	4
BP204T	Pathophysiology – Theory	3	1	4
BP205T	Computer Applications in Pharmacy – Theory *	3	-	3
BP206T	Environmental sciences – Theory *	3	-	3
BP207P	Human Anatomy and Physiology II –Practical	4	-	2
BP208P	Pharmaceutical Organic Chemistry I– Practical	4	-	2
BP209P	Biochemistry – Practical	4	-	2
BP210P	Computer Applications in Pharmacy – Practical*	2	-	1
	Total	**32**	**4**	**29**

*****Non University Examination (NUE)

Table-III: Course of study for semester III

Course code	Name of the course	No. of hours	Tutorial	Credit points
BP301T	Pharmaceutical Organic Chemistry II – Theory	3	1	4
BP302T	Physical Pharmaceutics I – Theory	3	1	4
BP303T	Pharmaceutical Microbiology – Theory	3	1	4
BP304T	Pharmaceutical Engineering – Theory	3	1	4
BP305P	Pharmaceutical Organic Chemistry II – Practical	4	-	2
BP306P	Physical Pharmaceutics I – Practical	4	-	2
BP307P	Pharmaceutical Microbiology – Practical	4	-	2
BP 308P	Pharmaceutical Engineering –Practical	4	-	2
	Total	**28**	**4**	**24**

Table-IV: Course of study for semester IV

Course code	Name of the course	No. of hours	Tutorial	Credit points
BP401T	Pharmaceutical Organic Chemistry III– Theory	3	1	4
BP402T	Medicinal Chemistry I – Theory	3	1	4
BP403T	Physical Pharmaceutics II – Theory	3	1	4
BP404T	Pharmacology I – Theory	3	1	4
BP405T	Pharmacognosy and Phytochemistry I– Theory	3	1	4
BP406P	Medicinal Chemistry I – Practical	4	-	2
BP407P	Physical Pharmaceutics II – Practical	4		2
BP408P	Pharmacology I – Practical	4	-	2
BP409P	Pharmacognosy and Phytochemistry I – Practical	4	-	2
	Total	**31**	**5**	**28**

Table-V: Course of study for semester V

Course code	Name of the course	No. of hours	Tutorial	Credit points
BP501T	Medicinal Chemistry II – Theory	3	1	4
BP502T	Industrial PharmacyI– Theory	3	1	4
BP503T	Pharmacology II – Theory	3	1	4
BP504T	Pharmacognosy and Phytochemistry II– Theory	3	1	4
BP505T	Pharmaceutical Jurisprudence – Theory	3	1	4
BP506P	Industrial PharmacyI – Practical	4	-	2
BP507P	Pharmacology II – Practical	4	-	2
BP508P	Pharmacognosy and Phytochemistry II – Practical	4	-	2
	Total	**27**	**5**	**26**

Table-VI: Course of study for semester VI

Course code	Name of the course	No. of hours	Tutorial	Credit points
BP601T	Medicinal Chemistry III – Theory	3	1	4
BP602T	Pharmacology III – Theory	3	1	4
BP603T	Herbal Drug Technology – Theory	3	1	4
BP604T	Biopharmaceutics and Pharmacokinetics – Theory	3	1	4
BP605T	Pharmaceutical Biotechnology – Theory	3	1	4
BP606T	Quality Assurance –Theory	3	1	4
BP607P	Medicinal chemistry III – Practical	4	-	2
BP608P	Pharmacology III – Practical	4	-	2
BP609P	Herbal Drug Technology – Practical	4	-	2
	Total	**30**	**6**	**30**

Table-VII: Course of study for semester VII

Course code	Name of the course	No. of hours	Tutorial	Credit points
BP701T	Instrumental Methods of Analysis – Theory	3	1	4
BP702T	Industrial PharmacyII – Theory	3	1	4
BP703T	Pharmacy Practice – Theory	3	1	4
BP704T	Novel Drug Delivery System – Theory	3	1	4
BP705P	Instrumental Methods of Analysis – Practical	4	-	2
BP706PS	Practice School*	12	-	6
	Total	**28**	**5**	**24**

***** Non University Examination (NUE)

Table-VIII: Course of study for semester VIII

Course code	Name of the course	No. of hours	Tutorial	Credit points
BP801T	Biostatistics and Research Methodology	3	1	4
BP802T	Social and Preventive Pharmacy	3	1	4
BP803ET	Pharma Marketing Management	3 + 3 = 6	1 + 1 = 2	4 + 4 = 8
BP804ET	Pharmaceutical Regulatory Science			
BP805ET	Pharmacovigilance			
BP806ET	Quality Control and Standardization of Herbals			
BP807ET	Computer Aided Drug Design			
BP808ET	Cell and Molecular Biology			
BP809ET	Cosmetic Science			
BP810ET	Experimental Pharmacology			
BP811ET	Advanced Instrumentation Techniques			
BP812ET	Dietary Supplements and Nutraceuticals			
BP813PW	Project Work	12	-	6
	Total	**24**	**4**	**22**

Table-IX: Semester wise credits distribution

Semester	Credit Points
I	**27/29$/30#**
II	29
III	26
IV	28
V	26
VI	26
VII	24
VIII	22
Extracurricular/ Co curricular activities	01*
Total credit points for the program	**209/211$/212#**

* The credit points assigned for extracurricular and or co-curricular activities shall be given by the Principals of the colleges and the same shall be submitted to the University. The criteria to acquire this credit point shall be defined by the colleges from time to time.

$Applicable ONLY for the students studied Physics / Chemistry / Botany / Zoology at HSC and appearing for Remedial Mathematics course.

#Applicable ONLY for the students studied Mathematics / Physics / Chemistry at HSC and appearing for Remedial Biology course.

10. Program Committee

1. The B. Pharm. program shall have a Program Committee constituted by the Head of the institution in consultation with all the Heads of the departments.

2. The composition of the Program Committee shall be as follows:

   A senior teacher shall be the Chairperson; One Teacher from each department handling B.Pharm courses; and four student representatives of the program (one from each academic year), nominated by the Head of the institution.

3. Duties of the Program Committee:

   i. Periodically reviewing the progress of the classes.
   ii. Discussing the problems concerning curriculum, syllabus and the conduct of classes.
   iii. Discussing with the course teachers on the nature and scope of assessment for the course and the same shall be announced to the students at the beginning of respective semesters.
   iv. Communicating its recommendation to the Head of the institution on academic matters.
   v. The Program Committee shall meet at least thrice in a semester preferably at the end of each Sessionalexam (Internal Assessment) and before the end semester exam.

11. Examinations/Assessments

The scheme for internal assessment and end semester examinations is given in Table – X.

11.1. End semester examinations

The End Semester Examinations for each theory and practical coursethrough semesters I to VIII shall beconducted by the university except for the subjects with asterix symbol (*) in table I and II for which examinations shall be conducted by the subject experts at college level and the marks/grades shall be submitted to the university.

Tables-X: Schemes for internal assessments and end semester examinations semester wise

Semester I

Course code	Name of the course	Internal Assessment				End Semester Exams		Total Marks
		Continuous Mode	Sessional Exams		Total	Marks	Duration	
			Marks	Duration				
BP101T	Human Anatomy and Physiology I– Theory	10	15	1 Hr	25	75	3 Hrs	100
BP102T	Pharmaceutical Analysis I – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP103T	Pharmaceutics I – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP104T	Pharmaceutical Inorganic Chemistry – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP105T	Communication skills – Theory *	5	10	1 Hr	15	35	1.5 Hrs	50
BP106RBT BP106RMT	Remedial Biology/ Mathematics – Theory*	5	10	1 Hr	15	35	1.5 Hrs	50
BP107P	Human Anatomy and Physiology – Practical	5	10	4 Hrs	15	35	4 Hrs	50
BP108P	Pharmaceutical Analysis I – Practical	5	10	4 Hrs	15	35	4 Hrs	50
BP109P	Pharmaceutics I – Practical	5	10	4 Hrs	15	35	4 Hrs	50
BP110P	Pharmaceutical Inorganic Chemistry – Practical	5	10	4 Hrs	15	35	4 Hrs	50
BP111P	Communication skills – Practical*	5	5	2 Hrs	10	15	2 Hrs	25
BP112RBP	Remedial Biology – Practical*	5	5	2 Hrs	10	15	2 Hrs	25
	Total	**70/75$/80#**	**115/125$/130#**	**23/24$/26# Hrs**	**185/200$/210#**	**490/525$/ 540#**	**31.5/33$/ 35# Hrs**	**675/725$/ 750#**

#Applicable ONLY for the students studied Mathematics / Physics / Chemistry at HSC and appearing for Remedial Biology (RB)course.

$Applicable ONLY for the students studied Physics / Chemistry / Botany / Zoology at HSC and appearing for Remedial Mathematics (RM)course.

* Non University Examination (NUE)

Semester II

Course code	Name of the course	Internal Assessment				End Semester Exams		Total Marks
		Continuous Mode	Sessional Exams		Total	Marks	Duration	
			Marks	Duration				
BP201T	Human Anatomy and Physiology II – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP202T	Pharmaceutical Organic Chemistry I – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP203T	Biochemistry – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP204T	Pathophysiology – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP205T	Computer Applications in Pharmacy – Theory*	10	15	1 Hr	25	50	2 Hrs	75
BP206T	Environmental sciences – Theory*	10	15	1 Hr	25	50	2 Hrs	75
BP207P	Human Anatomy and Physiology II –Practical	5	10	4 Hrs	15	35	4 Hrs	50
BP208P	Pharmaceutical Organic Chemistry I– Practical	5	10	4 Hrs	15	35	4 Hrs	50
BP209P	Biochemistry – Practical	5	10	4 Hrs	15	35	4 Hrs	50
BP210P	Computer Applications in Pharmacy – Practical*	5	5	2 Hrs	10	15	2 Hrs	25
	Total	**80**	**125**	**20 Hrs**	**205**	**520**	**30 Hrs**	**725**

***** The subject experts at college level shall conduct examinations

Semester III

Course code	Name of the course	Internal Assessment				End Semester Exams		Total Marks
		Continuous Mode	Sessional Exams		Total	Marks	Duration	
			Marks	Duration				
BP301T	Pharmaceutical Organic Chemistry II – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP302T	PhysicalPharmaceuticsI –Theory	10	15	1 Hr	25	75	3 Hrs	100
BP303T	Pharmaceutical Microbiology – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP304T	Pharmaceutical Engineering – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP305P	Pharmaceutical Organic Chemistry II – Practical	5	10	4 Hr	15	35	4 Hrs	50
BP306P	Physical Pharmaceutics I – Practical	5	10	4 Hr	15	35	4 Hrs	50
BP307P	Pharmaceutical Microbiology – Practical	5	10	4 Hr	15	35	4 Hrs	50
BP308P	Pharmaceutical Engineering – Practical	5	10	4 Hr	15	35	4 Hrs	50
Total		**60**	**100**	**20**	**160**	**440**	**28Hrs**	**600**

Semester IV

Course code	Name of the course	Internal Assessment				End Semester Exams		Total Marks
		Continuous Mode	Sessional Exams		Total	Marks	Duration	
			Marks	Duration				
BP401T	Pharmaceutical Organic Chemistry III– Theory	10	15	1 Hr	25	75	3 Hrs	100
BP402T	Medicinal Chemistry I – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP403T	Physical Pharmaceutics II – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP404T	Pharmacology I – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP405T	Pharmacognosy I – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP406P	Medicinal Chemistry I – Practical	5	10	4 Hr	15	35	4 Hrs	50
BP407P	Physical Pharmaceutics II – Practical	5	10	4 Hrs	15	35	4 Hrs	50
BP408P	Pharmacology I – Practical	5	10	4 Hrs	15	35	4 Hrs	50
BP409P	Pharmacognosy I – Practical	5	10	4 Hrs	15	35	4 Hrs	50
Total		**70**	**115**	**21 Hrs**	**185**	**515**	**31 Hrs**	**700**

Semester V

Course code	Name of the course	Internal Assessment				End Semester Exams		Total Marks
		Continuous Mode	Sessional Exams		Total	Marks	Duration	
			Marks	Duration				
BP501T	Medicinal Chemistry II – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP502T	Industrial PharmacyI– Theory	10	15	1 Hr	25	75	3 Hrs	100
BP503T	Pharmacology II – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP504T	Pharmacognosy II – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP505T	Pharmaceutical Jurisprudence – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP506P	Industrial PharmacyI– Practical	5	10	4 Hr	15	35	4 Hrs	50
BP507P	Pharmacology II – Practical	5	10	4 Hr	15	35	4 Hrs	50
BP508P	Pharmacognosy II – Practical	5	10	4 Hr	15	35	4 Hrs	50
Total		**65**	**105**	**17 Hr**	**170**	**480**	**27 Hrs**	**650**

Semester VI

Course code	Name of the course	Internal Assessment				End Semester Exams		Total Marks
		Continuous Mode	Sessional Exams		Total	Marks	Duration	
			Marks	Duration				
BP601T	Medicinal Chemistry III – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP602T	Pharmacology III – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP603T	Herbal Drug Technology – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP604T	Biopharmaceutics and Pharmacokinetics – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP605T	Pharmaceutical Biotechnology– Theory	10	15	1 Hr	25	75	3 Hrs	100
BP606T	Quality Assurance– Theory	10	15	1 Hr	25	75	3 Hrs	100
BP607P	Medicinal chemistry III – Practical	5	10	4 Hrs	15	35	4 Hrs	50
BP608P	Pharmacology III – Practical	5	10	4 Hrs	15	35	4 Hrs	50
BP609P	Herbal Drug Technology – Practical	5	10	4 Hrs	15	35	4 Hrs	50
Total		**75**	**120**	**18 Hrs**	**195**	**555**	**30 Hrs**	**750**

Semester VII

Course code	Name of the course	Internal Assessment				End Semester Exams		Total Marks
		Continuous Mode	Sessional Exams		Total	Marks	Duration	
			Marks	Duration				
BP701T	Instrumental Methods of Analysis – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP702T	Industrial Pharmacy – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP703T	Pharmacy Practice – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP704T	Novel Drug Delivery System – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP705 P	Instrumental Methods of Analysis – Practical	5	10	4 Hrs	15	35	4 Hrs	50
BP706 PS	Practice School*	25	-	-	25	125	5 Hrs	150
Total		**70**	**70**	**8Hrs**	**140**	**460**	**21 Hrs**	**600**

***** The subject experts at college level shall conduct examinations

Semester VIII

Course code	Name of the course	Internal Assessment				End Semester Exams		Total Marks
		Continuous Mode	Sessional Exams		Total	Marks	Duration	
			Marks	Duration				
BP801T	Biostatistics and Research Methodology – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP802T	Social and Preventive Pharmacy – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP803ET	Pharmaceutical Marketing – Theory	10 + 10 = 20	15 + 15 = 30	1 + 1 = 2 Hrs	25 + 25 = 50	75 + 75 = 150	3 + 3 = 6 Hrs	100 + 100 = 200
BP804ET	Pharmaceutical Regulatory Science – Theory							
BP805ET	Pharmacovigilance – Theory							
BP806ET	Quality Control and Standardization of Herbals – Theory							
BP807ET	Computer Aided Drug Design – Theory							
BP808ET	Cell and Molecular Biology – Theory							
BP809ET	Cosmetic Science – Theory							
BP810ET	Experimental Pharmacology – Theory							
BP811ET	Advanced Instrumentation Techniques – Theory							
BP812PW	Project Work	-	-	-	-	150	4 Hrs	150
	Total	**40**	**60**	**4 Hrs**	**100**	**450**	**16 Hrs**	**550**

11.2. Internal assessment: Continuous mode

The marks allocated for Continuous mode of Internal Assessment shall be awarded as per the scheme given below.

Table-XI:Scheme for awarding internal assessment: Continuous mode

Theory		
Criteria	**Maximum Marks**	
Attendance (Refer Table – XII)	4	2
Academic activities (Average of any 3 activities e.g. quiz, assignment, open book test, field work, group discussion and seminar)	3	1.5
Student – Teacher interaction	3	1.5
Total	**10**	**5**
Practical		
Attendance (Refer Table – XII)	2	
Based on Practical Records, Regular viva voce, etc.	3	
Total	**5**	

Table- XII: Guidelines for the allotment of marks for attendance

Percentage of Attendance	**Theory**	**Practical**
95 – 100	4	2
90 – 94	3	1.5
85 – 89	2	1
80 – 84	1	0.5
Less than 80	0	0

11.2.1. Sessional Exams

Two Sessional exams shall be conducted for each theory / practical course as per the schedule fixed by the college(s). The scheme of question paper for theory and practical Sessional examinations is given below. The average marks of two Sessional exams shall be computed for internal assessment as per the requirements given in tables – X.

Sessional exam shall be conducted for 30 marks for theory and shall be computed for 15 marks. Similarly Sessional exam for practical shall be conducted for 40 marks and shall be computed for 10 marks.

Question paper pattern for theory Sessional examinations

For subjects having University examination

I. Multiple Choice Questions (MCQs)	=	10 x 1 = 10
OR		OR
Objective Type Questions (5 x 2)	=	05 x 2 = 10
(Answer all the questions)		
I. Long Answers (Answer 1 out of 2)	=	1 x 10 = 10
II. Short Answers (Answer 2 out of 3)	=	2 x 5 = 10

Total	=	30 marks

For subjects having Non University Examination

I. Long Answers (Answer 1 out of 2)	=	1 x 10 = 10
II. Short Answers (Answer 4 out of 6)	=	4 x 5 = 20

Total	=	30 marks

Question paper pattern for practical sessional examinations

I. Synopsis	=	10
II. Experiments	=	25
III. Viva voce	=	05

Total	=	40 marks
		----------

12. Promotion and award of grades

A student shall be declared PASSand eligible for getting gradein a course of B.Pharm.program if he/she secures at least 50% marks in that particular course including internal assessment.For example, to be declared as PASS and to get grade, the student has to secure a minimum of 50 marks for the total of 100 including continuous mode of assessment and end semester theory examination and has to secure a minimum of 25 marks for the total 50 including internal assessment and end semester practical examination.

13. Carry forward of marks

In case a studentfails to secure the minimum 50% in any Theory or Practical course as specified in 12,then he/she shall reappear for the end semester examinationof that course. However his/her marks of the Internal Assessmentshallbe carried overand he/she shall be entitled for grade obtained by him/her on passing.

14. Improvement of internal assessment

A studentshall have the opportunity to improvehis/her performance only oncein the Sessional exam component of the internal assessment. The re-conduct of the Sessional exam shall be completed before the commencement of next end semester theory examinations.

15. Re-examination of end semester examinations

Reexamination ofend semester examinationshall be conducted as per the schedule given in table XIII. The exact dates of examinations shall be notified from time to time.

Table-XIII: Tentative schedule of end semester examinations

Semester	For Regular Candidates	For Failed Candidates
I, III, V and VII	November / December	May / June
II, IV, VI and VIII	May / June	November / December

Question paper pattern for end semester theory examinations

For 75 marks paper

I. Multiple Choice Questions(MCQs) = 20 x 1 = 20
OR OR
Objective Type Questions (10 x 2) = 10 x 2 = 20
(Answer all the questions)
II. Long Answers (Answer 2 out of 3) = 2 x 10 = 20
III. Short Answers (Answer 7 out of 9) = 7 x 5 = 35

Total = 75 marks

For 50 marks paper

I. Long Answers (Answer 2 out of 3) = 2 x 10 = 20
II. Short Answers (Answer 6 out of 8) = 6 x 5 = 30

Total = 50 marks

For 35 marks paper

I. Long Answers (Answer 1 out of 2) = 1 x 10 =10
II. Short Answers (Answer 5 out of 7) = 5 x 5 = 25

Total = 35 marks

Question paper pattern for end semester practical examinations

I. Synopsis = 5
II. Experiments = 25
III. Viva voce = 5

Total = 35 marks

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16. Academic Progression:

No student shall be admitted to any examination unless he/she fulfills the norms given in 6. Academic progression rules are applicable as follows:

A student shall be eligible to carry forward all the courses of I, II and III semesters till the IV semester examinations. However, he/she shall not be eligible to attend the courses of V semester until all the courses of I and II semesters are successfully completed.

A student shall be eligible to carry forward all the courses of III, IV and V semesters till the VI semester examinations. However, he/she shall not be eligible to attend the courses of VII semester until all the courses of I, II, III and IV semesters are successfully completed.

A student shall be eligible to carry forward all the courses of V, VI and VII semesters till the VIII semester examinations. However, he/she shall not be eligible to get the course completion certificate until all the courses of I, II, III, IV, V and VI semesters are successfully completed.

A student shall be eligible to get his/her CGPA upon successful completion of the courses of I to VIII semesters within the stipulated time period as per the norms specified in 26.

A lateral entry student shall be eligible to carry forward all the courses of III, IV and V semesters till the VI semester examinations. However, he/she shall not be eligible to attend the courses of VII semester until all the courses of III and IV semesters are successfully completed.

A lateral entry student shall be eligible to carry forward all the courses of V, VI and VII semesters till the VIII semester examinations. However, he/she shall not be eligible to get the course completion certificate until all the courses of III, IV, V and VI semesters are successfully completed.

A lateral entry student shall be eligible to get his/her CGPA upon successful completion of the courses of III to VIII semesters within the stipulated time period as per the norms specified in 26.

Any student who hasgiven more than 4 chances for successful completion of I / III semester courses and more than 3 chances for successful completion of II / IV semester courses shall be permitted to attend V / VII semester classes ONLY during the subsequent academic year as the case may be. In simpler terms there shall NOT be any ODD BATCH for any semester.

Note: Grade ABshould be considered as failed and treated as one head for deciding academic progression. Such rules are also applicable for those students who fail to register for examination(s) of any course in any semester.

17. Grading of performances

17.1. Letter grades and grade points allocations:

Based on the performances, each student shall be awarded a final letter grade at the end of the semester for each course.The letter grades and their corresponding grade points are given in Table – XII.

Table – XII: Letter grades and grade points equivalent to Percentage of marks and performances

Percentage of Marks Obtained	Letter Grade	Grade Point	Performance
90.00 – 100	O	10	Outstanding
80.00 – 89.99	A	9	Excellent
70.00 – 79.99	B	8	Good
60.00 – 69.99	C	7	Fair
50.00 – 59.99	D	6	Average
Less than 50	F	0	Fail
Absent	AB	0	Fail

A learner who remains absent for any end semester examination shall be assigned a letter grade of ABand a corresponding grade point of zero. He/she should reappear for the said evaluation/examination in due course.

18. The Semester grade point average (SGPA)

The performance of a student in a semester is indicated by a number called 'Semester Grade Point Average' (SGPA). The SGPA is the weighted average of the grade points obtainedin all the courses by the student during the semester. For example, if a student takes five courses(Theory/Practical) in a semester with credits C1, C2, C3, C4 and C5 and the student's grade pointsin these courses are G1, G2, G3, G4 and G5, respectively, and then students' SGPA is equal to:

$$\text{SGPA} = \frac{C_1G_1 + C_2G_2 + C_3G_3 + C_4G_4 + C_5G_5}{C_1 + C_2 + C_3 + C_4 + C_5}$$

The SGPA is calculated to two decimal points.It should be noted that, the SGPA for any semester shall take into consideration the F and ABSgrade awarded in that semester. For example if a learner has a F or ABS grade in course 4, theSGPA shall then be computed as:

$$SGPA = \frac{C_1G_1 + C_2G_2 + C_3G_3 + C_4 * ZERO + C_5G_5}{C_1 + C_2 + C_3 + C_4 + C_5}$$

19. Cumulative Grade Point Average (CGPA)

The CGPA is calculated with the SGPA of all the VIII semesters to two decimal points and is indicated in final grade report card/final transcript showing the grades of all VIII semesters and their courses. The CGPA shall reflect the failed statusin case of F grade(s),till the course(s) is/are passed. When the course(s)is/are passedby obtaining a pass grade on subsequent examination(s) theCGPA shall only reflect the new grade and not the fail grades earned earlier.The CGPA is calculated as:

$$CGPA = \frac{C_1S_1 + C_2S_2 + C_3S_3 + C_4S_4 + C_5S_5 + C_6S_6 + C_7S_7 + C_8S_8}{C_1 + C_2 + C_3 + C_4 + C_5 + C_6 + C_7 + C_8}$$

where $C_1, C_2, C_3,\ldots$ is the total number of credits for semester I,II,III,…. and $S_1,S_2, S_3,\ldots$is the SGPA of semester I,II,III,…. .

20. Declaration of class

The class shall be awarded on the basis of CGPA as follows:

First Class with Distinction	= CGPA of. 7.50 and above
First Class	= CGPA of 6.00 to 7.49
Second Class	= CGPA of 5.00 to 5.99

21. Project work

All the students shall undertake a projectunder the supervision of a teacher and submit a report. The area of the project shall directly relate any one of the elective subject opted by the student in semester VIII. The project shall be carried out in group not exceeding 5 in number. The project report shall be submitted in triplicate (typed & bound copy not less than 25 pages).

The internal and external examiner appointed by the University shall evaluate the project at the time of the Practical examinations of other semester(s). Students shall be evaluated in groups for four hours (i.e., about half an hour for a group of five students). The projects shall be evaluated as per the criteria given below.

Evaluation of Dissertation Book:

Objective(s) of the work done		15 Marks
Methodology adopted		20 Marks
Results and Discussions		20 Marks
Conclusions and Outcomes		20 Marks
	Total	**75 Marks**

Evaluation of Presentation:

Presentation of work		25 Marks
Communication skills		20 Marks
Question and answer skills		30 Marks
	Total	**75 Marks**

Explanation: The 75 marks assigned to the dissertation book shall be same for all the students in a group. However, the 75 marks assigned for presentation shall be awarded based on the performance of individual students in the given criteria.

22. Industrial training (Desirable)

Every candidate shall be required to work for at least 150 hours spread over four weeks in a Pharmaceutical Industry/Hospital. It includes Production unit, Quality Control department, Quality Assurance department, Analytical laboratory, Chemical manufacturing unit, Pharmaceutical R&D, Hospital (Clinical Pharmacy), Clinical Research Organization, Community Pharmacy, etc. After the Semester – VI and before the commencement of Semester – VII, and shall submit satisfactory report of such work and certificate duly signed by the authority of training organization to the head of the institute.

23. Practice School

In the VII semester, every candidate shall undergo practice school for a period of 150 hours evenly distributed throughout the semester. The student shall opt any one of the domains for practice school declared by the program committee from time to time.

At the end of the practice school, every student shall submit a printed report (in triplicate) on the practice school he/she attended (not more than 25 pages). Along with the exams of semester VII, the report submitted by the student, knowledge and skills acquired by the student through practice school shall be evaluated by the subject experts at college leveland grade point shall be awarded.

24. Award of Ranks

Ranks and Medals shall be awarded on the basis of final CGPA. However, candidates who fail in one or more courses during the B.Pharm program shall not be eligible for award of ranks.Moreover, the candidates should have completed the B. Pharm program in minimum prescribed number of years, (four years) for the award of Ranks.

25. Award of degree

Candidates who fulfill the requirements mentioned above shall be eligible for award of degree during the ensuing convocation.

26. Duration for completion of the program of study

The duration for the completion of the program shall be fixed as double the actual duration of the program and the students have to pass within the said period, otherwise they have to get fresh Registration.

27. Re-admission after break of study

Candidate who seeks re-admission to the program after break of study has to get the approval from the university by paying a condonation fee.

No condonation is allowed for the candidate who has more than 2 years of break up period and he/she has to rejoin the program by paying the required fees.

CHAPTER - II: SYLLABUS

Semester I

BP101T. HUMAN ANATOMY AND PHYSIOLOGY-I (Theory)

45 Hours

Scope: This subject is designed to impart fundamental knowledge on the structure and functions of the various systems of the human body. It also helps in understanding both homeostatic mechanisms. The subject provides the basic knowledge required to understand the various disciplines of pharmacy.

Objectives: Upon completion of this course the student should be able to

1. Explain the gross morphology, structure and functions of various organs of the human body.
2. Describe the various homeostatic mechanisms and their imbalances.
3. Identify the various tissues and organs of different systems of human body.
4. Perform the various experiments related to special senses and nervous system.
5. Appreciate coordinated working pattern of different organs of each system

Course Content:

Unit I **10 hours**

- **Introduction to human body**
  Definition and scope of anatomy and physiology, levels of structural organization and body systems, basic life processes, homeostasis, basic anatomical terminology.
- **Cellular level of organization**
  Structure and functions of cell, transport across cell membrane, cell division, cell junctions. General principles of cell communication, intracellular signaling pathway activation by extracellular signal molecule, Forms of intracellular signaling: a) Contact-dependent b) Paracrine c) Synaptic d) Endocrine
- **Tissue level of organization**
  Classification of tissues, structure, location and functions of epithelial, muscular and nervous and connective tissues.

Unit II **10 hours**

- **Integumentary system**
  Structure and functions of skin
- **Skeletal system**
  Divisions of skeletal system, types of bone, salient features and functions of bones of axial and appendicular skeletal system
  Organization of skeletal muscle, physiology of muscle contraction, neuromuscular junction

- **Joints**
  Structural and functional classification, types of joints movements and its articulation

Unit III **10 hours**

- **Body fluids and blood**
- Body fluids, composition and functions of blood, hemopoeisis, formation of hemoglobin, anemia, mechanisms of coagulation, blood grouping, Rh factors, transfusion, its significance and disorders of blood, Reticulo endothelial system.
- **Lymphatic system**

  Lymphatic organs and tissues, lymphatic vessels, lymph circulation and functions of lymphatic system

Unit IV **08 hours**

Peripheral nervous system:
Classification of peripheral nervous system: Structure and functions of sympathetic and parasympathetic nervous system.
Origin and functions of spinal and cranial nerves.

- **Special senses**
  Structure and functions of eye, ear, nose and tongue and their disorders.

Unit V **07 hours**

- **Cardiovascular system**
  Heart – anatomy of heart, blood circulation, blood vessels, structure and functions of artery, vein and capillaries, elements of conduction system of heart and heart beat, its regulation by autonomic nervous system, cardiac output, cardiac cycle. Regulation of blood pressure, pulse, electrocardiogram and disorders of heart.

BP107P. HUMAN ANATOMY AND PHYSIOLOGY (Practical)

4 Hours/week

Practical physiology is complimentary to the theoretical discussions in physiology. Practicals allow the verification of physiological processes discussed in theory classes through experiments on living tissue, intact animals or normal human beings. This is helpful for developing an insight on the subject**.**

1. Study of compound microscope.
2. Microscopic study of epithelial and connective tissue
3. Microscopic study of muscular and nervous tissue
4. Identification of axial bones
5. Identification of appendicular bones

6. Introduction to hemocytometry.
7. Enumeration of white blood cell (WBC) count
8. Enumeration of total red blood corpuscles (RBC) count
9. Determination of bleeding time
10. Determination of clotting time
11. Estimation of hemoglobin content
12. Determination of blood group.
13. Determination of erythrocyte sedimentation rate (ESR).
14. Determination of heart rate and pulse rate.
15. Recording of blood pressure.

Recommended Books (Latest Editions)

1. Essentials of Medical Physiology by K. Sembulingam and P. Sembulingam. Jaypee brothers medical publishers, New Delhi.
2. Anatomy and Physiology in Health and Illness by Kathleen J.W. Wilson, Churchill Livingstone, New York
3. Physiological basis of Medical Practice-Best and Tailor. Williams & Wilkins Co,Riverview,MI USA
4. Text book of Medical Physiology- Arthur C,Guyton andJohn.E. Hall. Miamisburg, OH, U.S.A.
5. Principles of Anatomy and Physiology by Tortora Grabowski. Palmetto, GA, U.S.A.

6. Textbook of Human Histology by Inderbir Singh, Jaypee brother's medical publishers, New Delhi.
7. Textbook of Practical Physiology by C.L. Ghai, Jaypee brother's medical publishers, New Delhi.
8. Practical workbook of Human Physiology by K. Srinageswari and Rajeev Sharma, Jaypee brother's medical publishers, New Delhi.

Reference Books (Latest Editions)

1. Physiological basis of Medical Practice-Best and Tailor. Williams & Wilkins Co, Riverview, MI USA
2. Text book of Medical Physiology- Arthur C, Guyton and John. E. Hall. Miamisburg, OH, U.S.A.
3. Human Physiology (vol 1 and 2) by Dr. C.C. Chatterrje ,Academic Publishers Kolkata

BP102T. PHARMACEUTICAL ANALYSIS (Theory)

45 Hours

Scope: This course deals with the fundamentals of analytical chemistry and principles of electrochemical analysis of drugs

Objectives: Upon completion of the course student shall be able to

- understand the principles of volumetric and electro chemical analysis
- carryout various volumetric and electrochemical titrations
- develop analytical skills

Course Content:

UNIT-I **10 Hours**

(a) Pharmaceutical analysis- Definition and scope

i) Different techniques of analysis

ii) Methods of expressing concentration

iii) Primary and secondary standards.

iv) Preparation and standardization of various molar and normal solutions- Oxalic acid, sodium hydroxide, hydrochloric acid, sodium thiosulphate, sulphuric acid, potassium permanganate and ceric ammonium sulphate

(b)Errors: Sources of errors, types of errors, methods of minimizing errors, accuracy, precision and significant figures

(c)Pharmacopoeia, Sources of impurities in medicinal agents,limit tests.

UNIT-II **10 Hours**

- **Acid base titration**: Theories of acid base indicators, classification of acid base titrations and theory involved in titrations of strong, weak, and very weak acids and bases, neutralization curves
- **Non aqueous titration**: Solvents, acidimetry and alkalimetry titration and estimation of Sodium benzoate and Ephedrine HCl

UNIT-III **10 Hours**

- **Precipitation titrations**: Mohr's method, Volhard's, Modified Volhard's, Fajans method, estimation of sodium chloride.
- **Complexometric titration**: Classification, metal ion indicators, masking and demasking reagents, estimation of Magnesium sulphate, and calcium gluconate.
- **Gravimetry**: Principle and steps involved in gravimetric analysis. Purity of the precipitate: co-precipitation and post precipitation, Estimation of barium sulphate.

- Basic Principles,methods and application of diazotisation titration.

UNIT-IV **08 Hours**

Redox titrations

(a) Concepts of oxidation and reduction

(b) Types of redox titrations (Principles and applications)

Cerimetry, Iodimetry, Iodometry, Bromatometry, Dichrometry, Titration with potassium iodate

UNIT-V **07 Hours**

- **Electrochemical methods of analysis**
  - **Conductometry**- Introduction, Conductivity cell, Conductometric titrations, applications.
  - **Potentiometry** - Electrochemical cell, construction and working of reference (Standard hydrogen, silver chloride electrode and calomel electrode) and indicator electrodes (metal electrodes and glass electrode), methods to determine end point of potentiometric titration and applications.
  - **Polarography** - Principle, Ilkovic equation, construction and working of dropping mercury electrode and rotating platinum electrode, applications

BP108P. PHARMACEUTICAL ANALYSIS (Practical)

4 Hours / Week

I **Limit Test of the following**
- (1) Chloride
- (2) Sulphate
- (3) Iron
- (4) Arsenic

II **Preparation and standardization of**
- (1) Sodium hydroxide
- (2) Sulphuric acid
- (3) Sodium thiosulfate
- (4) Potassium permanganate
- (5) Ceric ammonium sulphate

III **Assay of the following compounds along with Standardization of Titrant**
- (1) Ammonium chloride by acid base titration
- (2) Ferrous sulphate by Cerimetry
- (3) Copper sulphate by Iodometry
- (4) Calcium gluconate by complexometry
- (5) Hydrogen peroxide by Permanganometry
- (6) Sodium benzoate by non-aqueous titration
- (7) Sodium Chloride by precipitation titration

IV **Determination of Normality by electro-analytical methods**
- (1) Conductometric titration of strong acid against strong base
- (2) Conductometric titration of strong acid and weak acid against strong base
- (3) Potentiometric titration of strong acid against strong base

Recommended Books: (Latest Editions)

1. A.H. Beckett & J.B. Stenlake's, Practical Pharmaceutical Chemistry Vol I & II, Stahlone Press of University of London
2. A.I. Vogel, Text Book of Quantitative Inorganic analysis
3. P. Gundu Rao, Inorganic Pharmaceutical Chemistry
4. Bentley and Driver's Textbook of Pharmaceutical Chemistry
5. John H. Kennedy, Analytical chemistry principles
6. Indian Pharmacopoeia.

BP103T. PHARMACEUTICS- I (Theory)

45 Hours

Scope: This course is designed to impart a fundamental knowledge on the preparatory pharmacy with arts and science of preparing the different conventional dosage forms.

Objectives: Upon completion of this course the student should be able to:

- Know the history of profession of pharmacy
- Understand the basics of different dosage forms, pharmaceutical incompatibilities and pharmaceutical calculations
- Understand the professional way of handling the prescription
- Preparation of various conventional dosage forms

Course Content:

UNIT – I **10 Hours**

- **Historical background and development of profession of pharmacy**: History of profession of Pharmacy in India in relation to pharmacy education, industry and organization, Pharmacy as a career, Pharmacopoeias: Introduction to IP, BP, USP and Extra Pharmacopoeia.
- **Dosage forms:** Introduction to dosage forms, classification and definitions
- **Prescription:** Definition, Parts of prescription, handling of Prescription and Errors in prescription.
- **Posology:** Definition, Factors affecting posology. Pediatric dose calculations based on age, body weight and body surface area.

UNIT – II **10 Hours**

- **Pharmaceutical calculations**: Weights and measures – Imperial & Metric system, Calculations involving percentage solutions, alligation, proof spirit and isotonic solutions based on freezing point and molecular weight.

- **Powders:** Definition, classification, advantages and disadvantages,Simple & compound powders – official preparations, dusting powders, effervescent, efflorescent and hygroscopic powders, eutectic mixtures. Geometric dilutions.

- **Liquid dosage forms:** Advantages and disadvantages of liquid dosage forms. Excipients used in formulation of liquid dosage forms. Solubility enhancement techniques

UNIT – III **08 Hours**

- **Monophasic liquids:** Definitions and preparations of Gargles, Mouthwashes, Throat Paint, Eardrops, Nasal drops, Enemas, Syrups, Elixirs, Liniments and Lotions.
- **Biphasic liquids:**
- **Suspensions:** Definition, advantages and disadvantages, classifications, Preparation of suspensions; Flocculated and Deflocculated suspension & stability problems and methods to overcome.
- **Emulsions:** Definition, classification, emulsifying agent, test for the identification of type ofEmulsion, Methods of preparation & stability problems and methods to overcome.

UNIT – IV **08 Hours**

- **Suppositories**: Definition, types, advantages and disadvantages, types of bases, methods of preparations. Displacement value & its calculations, evaluation of suppositories.
- **Pharmaceutical incompatibilities**: Definition, classification, physical, chemical and therapeutic incompatibilities with examples.

UNIV – V **07 Hours**

- **Semisolid dosage forms:** Definitions, classification, mechanisms and factors influencing dermal penetration of drugs. Preparation of ointments, pastes, creams and gels. Excipients used in semi solid dosage forms. Evaluation of semi solid dosages forms

BP109P. PHARMACEUTICSI (Practical)

3 Hours / week

1 . Syrups

a) Syrup IP'66

b) Compound syrup of Ferrous Phosphate BPC'68

2. Elixirs a) Piperazine citrate elixir

b) Paracetamol pediatric elixir

3.Linctus a) Terpin Hydrate Linctus IP'66

b) Iodine Throat Paint (Mandles Paint)

4. Solutions

a) Strong solution of ammonium acetate

b) Cresol with soap solution

c) Lugol's solution

5. Suspensions

a) Calamine lotion

b) Magnesium Hydroxide mixture

c) Aluminimum Hydroxide gel

6. Emulsions a) Turpentine Liniment

b) Liquid paraffin emulsion

7. Powders and Granules

a) ORS powder (WHO)

b) Effervescent granules

c)Dusting powder

d)Divded powders

8. Suppositories

a) Glycero gelatin suppository

b) Coca butter suppository

c) Zinc Oxide suppository

8. Semisolids

a) Sulphur ointment

b) Non staining-iodine ointment with methyl salicylate

c) Carbopal gel

9. Gargles and Mouthwashes

a) Iodine gargle

b) Chlorhexidine mouthwash

Recommended Books: (Latest Editions)

1. H.C. Ansel et al., Pharmaceutical Dosage Form and Drug Delivery System, Lippincott Williams and Walkins, New Delhi.
2. Carter S.J., Cooper and Gunn's-Dispensing for Pharmaceutical Students, CBS publishers, New Delhi.
3. M.E. Aulton, Pharmaceutics, The Science& Dosage Form Design, Churchill Livingstone, Edinburgh.
4. Indian pharmacopoeia.
5. British pharmacopoeia.
6. Lachmann. Theory and Practice of Industrial Pharmacy,Lea& Febiger Publisher, The University of Michigan.
7. Alfonso R. Gennaro Remington. The Science and Practice of Pharmacy, Lippincott Williams, New Delhi.
8. Carter S.J., Cooper and Gunn's. Tutorial Pharmacy, CBS Publications, New Delhi.
9. E.A. Rawlins, Bentley's Text Book of Pharmaceutics, English Language Book Society, Elsevier Health Sciences, USA.
10. Isaac Ghebre Sellassie: Pharmaceutical Pelletization Technology, Marcel Dekker, INC, New York.
11. Dilip M. Parikh: Handbook of Pharmaceutical Granulation Technology, Marcel Dekker, INC, New York.
12. Francoise Nieloud and Gilberte Marti-Mestres: Pharmaceutical Emulsions and Suspensions, Marcel Dekker, INC, New York.

BP104T. PHARMACEUTICAL INORGANIC CHEMISTRY (Theory)

45 Hours

Scope: This subject deals with the monographs of inorganic drugs and pharmaceuticals.

Objectives: Upon completion of course student shall be able to

- know the sources of impurities and methods to determine the impurities in inorganic drugs and pharmaceuticals
- understand the medicinal and pharmaceutical importance of inorganic compounds

Course Content:

UNIT I **10 Hours**

- **Impurities in pharmaceutical substances:** History of Pharmacopoeia, Sources and types of impurities, principle involved in the limit test for Chloride, Sulphate, Iron, Arsenic, Lead and Heavy metals, modified limit test for Chloride and Sulphate

  General methods of preparation, assay for the compounds superscripted with **asterisk (*),** properties and medicinal uses of inorganic compounds belonging to the following classes

UNIT II **10 Hours**

- **Acids, Bases and Buffers:** Buffer equations and buffer capacity in general, buffers in pharmaceutical systems, preparation, stability, buffered isotonic solutions, measurements of tonicity, calculations and methods of adjusting isotonicity.
- **Major extra and intracellular electrolytes**: Functions of major physiological ions, Electrolytes used in the replacement therapy: Sodium chloride*, Potassium chloride, Calcium gluconate* and Oral Rehydration Salt (ORS), Physiological acid base balance.
- **Dental products**: Dentifrices, role of fluoride in the treatment of dental caries, Desensitizing agents, Calcium carbonate, Sodium fluoride, and Zinc eugenol cement.

UNIT III **10 Hours**

- **Gastrointestinal agents**

  Acidifiers: Ammonium chloride* and Dil. HCl

  Antacid: Ideal properties of antacids, combinations of antacids, Sodium

Bicarbonate*, Aluminum hydroxide gel, Magnesium hydroxide mixture

Cathartics: Magnesium sulphate, Sodium orthophosphate, Kaolin and Bentonite

Antimicrobials: Mechanism, classification, Potassium permanganate, Boric acid, Hydrogen peroxide*, Chlorinated lime*, Iodine and its preparations

UNIT IV **08 Hours**

- **Miscellaneous compounds**

  Expectorants: Potassium iodide, Ammonium chloride*.

  Emetics: Copper sulphate*, Sodium potassium tartarate

  Haematinics: Ferrous sulphate*, Ferrous gluconate

  Poison and Antidote: Sodium thiosulphate*, Activated charcoal, Sodium nitrite333

  Astringents: Zinc Sulphate, Potash Alum

UNIT V **07 Hours**

- **Radiopharmaceuticals**: Radio activity, Measurement of radioactivity, Properties of α, β, γ radiations, Half life, radio isotopes and study of radio isotopes - Sodium iodide I^{131}, Storage conditions, precautions & pharmaceutical application of radioactive substances.

BP110P. PHARMACEUTICAL INORGANIC CHEMISTRY (Practical)

4 Hours / Week

I **Limit tests for following ions**

Limit test for Chlorides and Sulphates
Modified limit test for Chlorides and Sulphates
Limit test for Iron
Limit test for Heavy metals
Limit test for Lead
Limit test for Arsenic

II **Identification test**

Magnesium hydroxide
Ferrous sulphate
Sodium bicarbonate
Calcium gluconate
Copper sulphate

III **Test for purity**

Swelling power of Bentonite
Neutralizing capacity of aluminum hydroxide gel
Determination of potassium iodate and iodine in potassium Iodide

IV **Preparation of inorganic pharmaceuticals**

Boric acid
Potash alum
Ferrous sulphate

Recommended Books (Latest Editions)

1. A.H. Beckett & J.B. Stenlake's, Practical Pharmaceutical Chemistry Vol I & II, Stahlone Press of University of London, 4th edition.
2. A.I. Vogel, Text Book of Quantitative Inorganic analysis
3. P. Gundu Rao, Inorganic Pharmaceutical Chemistry, 3rd Edition
4. M.L Schroff, Inorganic Pharmaceutical Chemistry
5. Bentley and Driver's Textbook of Pharmaceutical Chemistry
6. Anand & Chatwal, Inorganic Pharmaceutical Chemistry
7. Indian Pharmacopoeia

BP105T.COMMUNICATION SKILLS (Theory)

30 Hours

Scope: This course will prepare the young pharmacy student to interact effectively with doctors, nurses, dentists, physiotherapists and other health workers. At the end of this course the student will get the soft skills set to work cohesively with the team as a team player and will add value to the pharmaceutical business.

Objectives:

Upon completion of the course the student shall be able to

1. Understand the behavioral needs for a Pharmacist to function effectively in the areas of pharmaceutical operation
2. Communicate effectively (Verbal and Non Verbal)
3. Effectively manage the team as a team player
4. Develop interview skills
5. Develop Leadership qualities and essentials

Course content:

UNIT – I **07 Hours**

- **Communication Skills:** Introduction, Definition, The Importance of Communication, The Communication Process – Source, Message, Encoding, Channel, Decoding, Receiver, Feedback, Context

- **Barriers to communication:** Physiological Barriers, Physical Barriers, Cultural Barriers, Language Barriers, Gender Barriers, Interpersonal Barriers, Psychological Barriers, Emotional barriers

- **Perspectives in Communication:** Introduction, Visual Perception, Language, Other factors affecting our perspective - Past Experiences, Prejudices, Feelings, Environment

UNIT – II **07 Hours**

- **Elements of Communication:** Introduction, Face to Face Communication - Tone of Voice, Body Language (Non-verbal communication), Verbal Communication, Physical Communication

- **Communication Styles:** Introduction, The Communication Styles Matrix with example for each -Direct Communication Style, Spirited Communication Style, Systematic Communication Style, Considerate Communication Style

UNIT – III **07 Hours**

- **Basic Listening Skills:** Introduction, Self-Awareness, Active Listening, Becoming an Active Listener, Listening in Difficult Situations
- **Effective Written Communication:** Introduction, When and When Not to Use Written Communication - Complexity of the Topic, Amount of Discussion' Required, Shades of Meaning, Formal Communication
- **Writing Effectively:** Subject Lines, Put the Main Point First, Know Your Audience, Organization of the Message

UNIT – IV **05 Hours**

- **Interview Skills:** Purpose of an interview, Do's and Dont's of an interview
- **Giving Presentations:** Dealing with Fears, Planning your Presentation, Structuring Your Presentation, Delivering Your Presentation, Techniques of Delivery

UNIT – V **04 Hours**

- **Group Discussion:** Introduction, Communication skills in group discussion, Do's and Dont's of group discussion

BP111P.COMMUNICATION SKILLS (Practical)

2 Hours / week

Thefollowing learning modules are to be conducted using wordsworth® English language lab software

Basic communication covering the following topics

Meeting People

Asking Questions

Making Friends

What did you do?

Do's and Dont's

Pronunciations covering the following topics

Pronunciation (Consonant Sounds)

Pronunciation and Nouns

Pronunciation (Vowel Sounds)

Advanced Learning

Listening Comprehension / Direct and Indirect Speech

Figures of Speech

Effective Communication

Writing Skills

Effective Writing

Interview Handling Skills

E-Mail etiquette

Presentation Skills

Recommended Books: (Latest Edition)

1. Basic communication skills for Technology, Andreja. J. Ruther Ford, 2nd Edition, Pearson Education, 2011
2. Communication skills, Sanjay Kumar, Pushpalata, 1stEdition, Oxford Press, 2011
3. Organizational Behaviour, Stephen .P. Robbins, 1stEdition, Pearson, 2013
4. Brilliant- Communication skills, Gill Hasson, 1stEdition, Pearson Life, 2011
5. The Ace of Soft Skills: Attitude, Communication and Etiquette for success, Gopala Swamy Ramesh, 5thEdition, Pearson, 2013
6. Developing your influencing skills, Deborah Dalley, Lois Burton, Margaret, Green hall, 1st Edition Universe of Learning LTD, 2010
7. Communication skills for professionals, Konar nira, 2ndEdition, New arrivals – PHI, 2011
8. Personality development and soft skills, Barun K Mitra, 1stEdition, Oxford Press, 2011
9. Soft skill for everyone, Butter Field, 1st Edition, Cengage Learning india pvt.ltd, 2011
10. Soft skills and professional communication, Francis Peters SJ, 1stEdition, Mc Graw Hill Education, 2011
11. Effective communication, John Adair, 4thEdition, Pan Mac Millan,2009
12. Bringing out the best in people, Aubrey Daniels, 2ndEdition, Mc Graw Hill, 1999

BP 106RBT.REMEDIAL BIOLOGY (Theory)

30 Hours

Scope: To learn and understand the components of living world, structure and functional system of plant and animal kingdom.

Objectives: Upon completion of the course, the student shall be able to

- know the classification and salient features of five kingdoms of life
- understand the basic components of anatomy & physiology of plant
- know understand the basic components of anatomy & physiology animal with special reference to human

UNIT I 07 Hours

Living world:

- Definition and characters of living organisms
- Diversity in the living world
- Binomial nomenclature
- Five kingdoms of life and basis of classification. Salient features of Monera, Potista, Fungi, Animalia and Plantae, Virus,

Morphology of Flowering plants

- Morphology of different parts of flowering plants – Root, stem, inflorescence, flower, leaf, fruit, seed.
- General Anatomy of Root, stem, leaf of monocotyledons & Dicotylidones.

UNIT II 07 Hours

Body fluids and circulation

- Composition of blood, blood groups, coagulation of blood
- Composition and functions of lymph
- Human circulatory system
- Structure of human heart and blood vessels
- Cardiac cycle, cardiac output and ECG

Digestion and Absorption

- Human alimentary canal and digestive glands
- Role of digestive enzymes
- Digestion, absorption and assimilation of digested food

Breathing and respiration

- Human respiratory system
- Mechanism of breathing and its regulation
- Exchange of gases, transport of gases and regulation of respiration
- Respiratory volumes

UNIT III **07 Hours**

Excretory products and their elimination

- Modes of excretion
- Human excretory system- structure and function
- Urine formation
- Rennin angiotensin system

Neural control and coordination

- Definition and classification of nervous system
- Structure of a neuron
- Generation and conduction of nerve impulse
- Structure of brain and spinal cord
- Functions of cerebrum, cerebellum, hypothalamus and medulla oblongata

Chemical coordination and regulation

- Endocrine glands and their secretions
- Functions of hormones secreted by endocrine glands

Human reproduction

- Parts of female reproductive system
- Parts of male reproductive system
- Spermatogenesis and Oogenesis
- Menstrual cycle

UNIT IV **05 Hours**

Plants and mineral nutrition:

- Essential mineral, macro and micronutrients
- Nitrogen metabolism, Nitrogen cycle, biological nitrogen fixation

Photosynthesis

- Autotrophic nutrition, photosynthesis, Photosynthetic pigments, Factors affecting photosynthesis.

UNIT V **04 Hours**

Plant respiration: Respiration, glycolysis, fermentation (anaerobic).

Plant growth and development

- Phases and rate of plant growth, Condition of growth,Introduction to plant growth regulators

Cell - The unit of life

- Structure and functions of cell and cell organelles.Cell division

Tissues

- Definition, types of tissues, location and functions.

Text Books

a. Text book of Biology by S. B. Gokhale
b. A Text book of Biology by Dr. Thulajappa and Dr. Seetaram.

Reference Books

a. A Text book of Biology by B.V. Sreenivasa Naidu
b. A Text book of Biology by Naidu and Murthy
c. Botany for Degree students By A.C.Dutta.
d.Outlines of Zoology by M. Ekambaranatha ayyer and T. N. Ananthakrishnan.
e. A manual for pharmaceutical biology practical by S.B. Gokhale and C. K. Kokate

BP112RBP.REMEDIAL BIOLOGY (Practical)

30 Hours

1. Introduction to experiments in biology
   a) Study of Microscope
   b) Section cutting techniques
   c) Mounting and staining
   d) Permanent slide preparation
2. Study of cell and its inclusions
3. Study of Stem, Root, Leaf, seed, fruit, flower and their modifications
4. Detailed study of frog by using computer models
5. Microscopic study and identification of tissues pertinent to Stem, Root Leaf, seed, fruit and flower
6. Identification of bones
7. Determination of blood group
8. Determination of blood pressure
9. Determination of tidal volume

Reference Books

1. Practical human anatomy and physiology. by S.R.Kale and R.R.Kale.
2. A Manual of pharmaceutical biology practical by S.B.Gokhale, C.K.Kokate and S.P.Shriwastava.
3. Biology practical manual according to National core curriculum .Biology forum of Karnataka. Prof .M.J.H.Shafi

BP 106RMT.REMEDIAL MATHEMATICS (Theory)

30 Hours

Scope: This is an introductory course in mathematics. This subject deals with the introduction to Partial fraction, Logarithm, matrices and Determinant, Analytical geometry, Calculus, differential equation and Laplace transform.

Objectives: Upon completion of the course the student shall be able to:-

1. Know the theory and their application in Pharmacy
2. Solve the different types of problems by applying theory
3. Appreciate the important application of mathematics in Pharmacy

Course Content:

UNIT – I **06 Hours**

- **Partial fraction**

Introduction, Polynomial, Rational fractions, Proper and Improper fractions, Partial fraction , Resolving into Partial fraction, Application of Partial Fraction in Chemical Kinetics and Pharmacokinetics

- **Logarithms**

Introduction, Definition, Theorems/Properties of logarithms, Common logarithms, Characteristic and Mantissa, worked examples, application of logarithm to solve pharmaceutical problems.

- **Function***:*

Real Valued function, Classification of real valued functions,

- **Limits and continuity** :

Introduction , Limit of a function, Definition of limit of a function ($\in$ - δ definition) , $\lim_{x \to a} \frac{x^n - a^n}{x - a} = na^{n-1}$, $\lim_{\theta \to 0} \frac{\sin\theta}{\theta} = 1,$

UNIT –II **06 Hours**

- **Matrices and Determinant:**

Introduction matrices, Types of matrices, Operation on matrices, Transpose of a matrix, Matrix Multiplication, Determinants, Properties of determinants , Product of determinants, Minors and co-Factors, Adjoint or adjugate of a square matrix , Singular and non-singular matrices, Inverse of a matrix, Solution of system of linear of equations using matrix method, Cramer's rule, Characteristic equation and roots of a square matrix, Cayley–Hamilton theorem,Applicationof Matrices in solving Pharmacokinetic equations

UNIT – III **06 Hours**

- **Calculus**

Differentiation : Introductions, Derivative of a function, Derivative of a constant, Derivative of a product of a constant and a function , Derivative of the sum or difference of two functions, Derivative of the product of two functions (product formula), Derivative of the quotient of two functions (Quotient formula) – **Without Proof**, Derivative of x^n *w.r.t*x,where *n* is any rational number, Derivative of e^x,, Derivative of $\log_e x$, Derivative of a^x,Derivative of trigonometric functions from first principles **(without Proof)**, Successive Differentiation, Conditions for a function to be a maximum or a minimum at a point. Application

UNIT – IV **06 Hours**

- **Analytical Geometry**

Introduction: Signs of the Coordinates, Distance formula,

Straight Line : Slope or gradient of a straight line, Conditions for parallelism and perpendicularity of two lines, Slope of a line joining two points, Slope – intercept form of a straight line

Integration:

Introduction, Definition, Standard formulae, Rules of integration , Method of substitution, Method of Partial fractions, Integration by parts, definite integrals, application

UNIT-V **06 Hours**

- **Differential Equations** : Some basic definitions, Order and degree, Equations in separable form , Homogeneous equations, Linear Differential equations, Exact equations, **Application in solving Pharmacokinetic equations**
- **Laplace Transform** : Introduction, Definition, Properties of Laplace transform, Laplace Transforms of elementary functions, Inverse Laplace transforms, Laplace transform of derivatives, Application to solve Linear differential equations, **Application in solving Chemical kinetics and Pharmacokinetics equations**

Recommended Books (Latest Edition)

1. Differential Calculus by Shanthinarayan
2. Pharmaceutical Mathematics with application to Pharmacy by Panchaksharappa Gowda D.H.
3. Integral Calculus by Shanthinarayan
4. Higher Engineering Mathematics by Dr.B.S.Grewal

Semester II

BP 201T. HUMAN ANATOMY AND PHYSIOLOGY-II (Theory)

45 Hours

Scope: This subject is designed to impart fundamental knowledge on the structure and functions of the various systems of the human body. It also helps in understanding both homeostatic mechanisms. The subject provides the basic knowledge required to understand the various disciplines of pharmacy.

Objectives: Upon completion of this course the student should be able to:

1. Explain the gross morphology, structure and functions of various organs of the human body.
2. Describe the various homeostatic mechanisms and their imbalances.
3. Identify the various tissues and organs of different systems of human body.
4. Perform the hematological tests like blood cell counts, haemoglobin estimation, bleeding/clotting time etc and also record blood pressure, heart rate, pulse and respiratory volume.
5. Appreciate coordinated working pattern of different organs of each system
6. Appreciate the interlinked mechanisms in the maintenance of normal functioning (homeostasis) of human body.

Course Content:

Unit I **10 hours**

- **Nervous system**

Organization of nervous system, neuron, neuroglia, classification and properties of nerve fibre, electrophysiology, action potential, nerve impulse, receptors, synapse, neurotransmitters.

Central nervous system: Meninges, ventricles of brain and cerebrospinal fluid.structure and functions of brain (cerebrum, brain stem, cerebellum), spinal cord (gross structure, functions of afferent and efferent nerve tracts,reflex activity)

Unit II **06 hours**

- **Digestive system**

Anatomy of GI Tract with special reference to anatomy and functions of stomach, (Acid production in the stomach, regulation of acid production through parasympathetic nervous system, pepsin role in protein digestion) small intestine

and large intestine, anatomy and functions of salivary glands, pancreas and liver, movements of GIT, digestion and absorption of nutrients and disorders of GIT.

- **Energetics**

  Formation and role of ATP, Creatinine Phosphate and BMR.

Unit III

- **Respiratory system** **10 hours**

  Anatomy of respiratory system with special reference to anatomy of lungs, mechanism of respiration, regulation of respiration

  Lung Volumes and capacities transport of respiratory gases, artificial respiration, and resuscitation methods.

- **Urinary system**
  Anatomy of urinary tract with special reference to anatomy of kidney and nephrons, functions of kidney and urinary tract, physiology of urine formation, micturition reflex and role of kidneys in acid base balance, role of RAS in kidney and disorders of kidney.

Unit IV **10 hours**

- **Endocrine system**
  Classification of hormones, mechanism of hormone action, structure and functions of pituitary gland, thyroid gland, parathyroid gland, adrenal
  gland, pancreas, pineal gland, thymus and their disorders.

Unit V **09 hours**

- **Reproductive system**

  Anatomy of male and female reproductive system, Functions of male and female reproductive system, sex hormones, physiology of menstruation, fertilization, spermatogenesis, oogenesis, pregnancy and parturition

- **Introduction to genetics**

  Chromosomes, genes and DNA, protein synthesis, genetic pattern of inheritance

BP 207 P. HUMAN ANATOMY AND PHYSIOLOGY (Practical)

4 Hours/week

Practical physiology is complimentary to the theoretical discussions in physiology. Practicals allow the verification of physiological processes discussed in theory classes through experiments on living tissue, intact animals or normal human beings. This is helpful for developing an insight on the subject**.**

1. To study the integumentary and special senses using specimen, models, etc.,
2. To study the nervous system using specimen, models, etc.,
3. To study the endocrine system using specimen, models, etc
4. To demonstrate the general neurological examination
5. To demonstrate the function of olfactory nerve
6. To examine the different types of taste.
7. To demonstrate the visual acuity
8. To demonstrate the reflex activity
9. Recording of body temperature
10. To demonstrate positive and negative feedback mechanism.
11. Determination of tidal volume and vital capacity.
12. Study of digestive, respiratory, cardiovascular systems, urinary and reproductive systems with the help of models, charts and specimens.
13. Recording of basal mass index .
14. Study of family planning devices and pregnancy diagnosis test.
15. Demonstration of total blood count by cell analyser
16. Permanent slides of vital organs and gonads.

Recommended Books (Latest Editions)

1. Essentials of Medical Physiology by K. Sembulingam and P. Sembulingam. Jaypee brothers medical publishers, New Delhi.
2. Anatomy and Physiology in Health and Illness by Kathleen J.W. Wilson, Churchill Livingstone, New York
3. Physiological basis of Medical Practice-Best and Tailor. Williams & Wilkins Co,Riverview,MI USA

4. Text book of Medical Physiology- Arthur C,Guyton andJohn.E. Hall. Miamisburg, OH, U.S.A.
5. Principles of Anatomy and Physiology by Tortora Grabowski. Palmetto, GA, U.S.A.
6. Textbook of Human Histology by Inderbir Singh, Jaypee brothers medical publishers, New Delhi.
7. Textbook of Practical Physiology by C.L. Ghai, Jaypee brothers medical publishers, New Delhi.
8. Practical workbook of Human Physiology by K. Srinageswari and Rajeev Sharma, Jaypee brother's medical publishers, New Delhi.

Reference Books:

1. Physiological basis of Medical Practice-Best and Tailor. Williams & Wilkins Co, Riverview, MI USA
2. Text book of Medical Physiology- Arthur C, Guyton and John. E. Hall. Miamisburg, OH, U.S.A.
3. Human Physiology (vol 1 and 2) by Dr. C.C. Chatterrje ,Academic Publishers Kolkata

BP202T. PHARMACEUTICAL ORGANIC CHEMISTRY –I (Theory)

45 Hours

Scope: This subject deals with classification and nomenclature of simple organic compounds, structural isomerism, intermediates forming in reactions, important physical properties, reactions and methods of preparation of these compounds. The syllabus also emphasizes on mechanisms and orientation of reactions.

Objectives: Upon completion of the course the student shall be able to

1. write the structure, name and the type of isomerism of the organic compound
2. write the reaction, name the reaction and orientation of reactions
3. account for reactivity/stability of compounds,
4. identify/confirm the identification of organic compound

Course Content:

General methods of preparation and reactions of compounds superscripted with asterisk (*) to be explained

To emphasize on definition, types, classification, principles/mechanisms, applications, examples and differences

UNIT-I **07 Hours**

- **Classification, nomenclature and isomerism**

  Classification of Organic Compounds

  Common and IUPAC systems of nomenclature of organic compounds

  (up to 10 Carbons open chain and carbocyclic compounds)

Structural isomerisms in organic compounds

UNIT-II10 Hours

- **Alkanes*, Alkenes* and Conjugated dienes***

  SP^3 hybridization in alkanes, Halogenation of alkanes, uses of paraffins.

  Stabilities of alkenes, SP^2 hybridization in alkenes

  E_1 and E_2 reactions – kinetics, order of reactivity of alkyl halides, rearrangement of carbocations, Saytzeffs orientation and evidences. E_1 verses E_2 reactions, Factors affecting E_1 and E_2 reactions. Ozonolysis, electrophilic addition reactions of alkenes, Markownikoff's orientation, free radical addition reactions of alkenes, Anti Markownikoff's orientation.

  Stability of conjugated dienes, Diel-Alder, electrophilic addition, free radical addition reactions of conjugated dienes, allylic rearrangement

UNIT-III10 Hours

- **Alkyl halides***

  SN_1 and SN_2 reactions - kinetics, order of reactivity of alkyl halides, stereochemistry and rearrangement of carbocations.

  SN_1 versus SN_2 reactions, Factors affecting SN_1 and SN_2 reactions

  Structure and uses of ethylchloride, Chloroform, trichloroethylene, tetrachloroethylene, dichloromethane, tetrachloromethane and iodoform.

- **Alcohols*-** Qualitative tests, Structure and uses of Ethyl alcohol, Methyl alcohol, chlorobutanol, Cetosteryl alcohol, Benzyl alcohol, Glycerol, Propylene glycol

UNIT-IV10 Hours

- **Carbonyl compounds* (Aldehydes and ketones)**

  Nucleophilic addition, Electromeric effect, aldol condensation, Crossed Aldol condensation, Cannizzaro reaction, Crossed Cannizzaro reaction, Benzoin condensation, Perkin condensation, qualitative tests, Structure and uses of Formaldehyde, Paraldehyde, Acetone, Chloral hydrate, Hexamine, Benzaldehyde, Vanilin, Cinnamaldehyde.

UNIT-V **08 Hours**

- **Carboxylic acids***

  Acidity of carboxylic acids, effect of substituents on acidity, inductive effect and qualitative tests for carboxylic acids ,amide and ester

  Structure and Uses of Acetic acid, Lactic acid, Tartaric acid, Citric acid, Succinic acid. Oxalic acid, Salicylic acid, Benzoic acid, Benzyl benzoate, Dimethyl phthalate, Methyl salicylate and Acetyl salicylic acid

- **Aliphatic amines* -** Basicity, effect of substituent on Basicity. Qualitative test, Structure and uses of Ethanolamine, Ethylenediamine, Amphetamine

BP208P. PHARMACEUTICAL ORGANIC CHEMISTRY -I (Practical)

4 Hours / week

1. Systematic qualitative analysis of unknown organic compounds like
    1. Preliminary test: Color, odour, aliphatic/aromatic compounds, saturation and unsaturation, etc.
    2. Detection of elements like Nitrogen, Sulphur and Halogen by Lassaigne's test
    3. Solubility test
    4. Functional group test like Phenols, Amides/ Urea, Carbohydrates, Amines, Carboxylic acids, Aldehydes and Ketones, Alcohols, Esters, Aromatic and Halogenated Hydrocarbons, Nitro compounds and Anilides.
    5. Melting point/Boiling point of organic compounds
    6. Identification of the unknown compound from the literature using melting point/ boiling point.
    7. Preparation of the derivatives and confirmation of the unknown compound by melting point/ boiling point.
    8. Minimum 5 unknown organic compounds to be analysed systematically.
2. Preparation of suitable solid derivatives from organic compounds
3. Construction of molecular models

Recommended Books (Latest Editions)

1. Organic Chemistry by Morrison and Boyd
2. Organic Chemistry by I.L. Finar , Volume-I
3. Textbook of Organic Chemistry by B.S. Bahl & Arun Bahl.
4. Organic Chemistry by P.L.Soni
5. Practical Organic Chemistry by Mann and Saunders.
6. Vogel's text book of Practical Organic Chemistry
7. Advanced Practical organic chemistry by N.K.Vishnoi.
8. Introduction to Organic Laboratory techniques by Pavia, Lampman and Kriz.
9. Reaction and reaction mechanism by Ahluwaliah/Chatwal.

BP203 T. BIOCHEMISTRY (Theory)

45 Hours

Scope: Biochemistry deals with complete understanding of the molecular levels of the chemical process associated with living cells. The scope of the subject is providing biochemical facts and the principles to understand metabolism of nutrient molecules in physiological and pathological conditions. It is also emphasizing on genetic organization of mammalian genome and hetero & autocatalytic functions of DNA.

Objectives: Upon completion of course student shell able to

1. Understand the catalytic role of enzymes, importance of enzyme inhibitors in design of new drugs, therapeutic and diagnostic applications of enzymes.
2. Understand the metabolism of nutrient molecules in physiological and pathological conditions.
3. Understand the genetic organization of mammalian genome and functions of DNA in the synthesis of RNAs and proteins.

Course Content:

UNIT I **08 Hours**

- **Biomolecules**

  Introduction, classification, chemical nature and biological role of carbohydrate, lipids, nucleic acids, amino acids and proteins.

- **Bioenergetics**

  Concept of free energy, endergonic and exergonic reaction, Relationship between free energy, enthalpy and entropy; Redox potential.

  Energy rich compounds; classification; biological significances of ATP and cyclic AMP

UNIT II **10 Hours**

- **Carbohydrate metabolism**

  Glycolysis – Pathway, energetics and significance

  Citric acid cycle- Pathway, energetics and significance

  HMP shunt and its significance; Glucose-6-Phosphate dehydrogenase (G6PD) deficiency

  Glycogen metabolism Pathways and glycogen storage diseases (GSD)

  Gluconeogenesis- Pathway and its significance

  Hormonal regulation of blood glucose level and Diabetes mellitus

- **Biological oxidation**

  Electron transport chain (ETC) and its mechanism.

Oxidative phosphorylation & its mechanism and substrate level phosphorylation

Inhibitors ETC and oxidative phosphorylation/Uncouplers

UNIT III **10 Hours**

- **Lipid metabolism**

  β-Oxidation of saturated fatty acid (Palmitic acid)

Formation and utilization of ketone bodies; ketoacidosis

De novo synthesis of fatty acids (Palmitic acid)

Biological significance of cholesterol and conversion of cholesterol into bile acids, steroid hormone and vitamin D

Disorders of lipid metabolism: Hypercholesterolemia, atherosclerosis, fatty liver and obesity.

- **Amino acid metabolism**

  General reactions of amino acid metabolism: Transamination, deamination & decarboxylation, urea cycle and its disorders

  Catabolism of phenylalanine and tyrosine and their metabolic disorders (Phenyketonuria, Albinism, alkeptonuria, tyrosinemia)

  Synthesis and significance of biological substances; 5-HT, melatonin, dopamine, noradrenaline, adrenaline

  Catabolism of heme; hyperbilirubinemia and jaundice

UNIT IV **10 Hours**

- **Nucleic acid metabolism and genetic information transfer**

  Biosynthesis of purine and pyrimidine nucleotides

  Catabolism of purine nucleotides and Hyperuricemia and Gout disease

  Organization of mammalian genome

  Structure of DNA and RNA and their functions

  DNA replication (semi conservative model)

  Transcription or RNA synthesis

  Genetic code, Translation or Protein synthesis and inhibitors

UNIT V **07 Hours**

- **Enzymes**

  Introduction, properties, nomenclature and IUB classification of enzymes

  Enzyme kinetics (Michaelis plot, Line Weaver Burke plot)

  Enzyme inhibitors with examples

  Regulation of enzymes: enzyme induction and repression, allosteric enzymes regulation

  Therapeutic and diagnostic applications of enzymes and isoenzymes

  Coenzymes –Structure and biochemical functions

BP 209 P. BIOCHEMISTRY (Practical)

4 Hours / Week

1. Qualitative analysis of carbohydrates (Glucose, Fructose, Lactose, Maltose, Sucrose and starch)
2. Identification tests for Proteins (albumin and Casein)
3. Quantitative analysis of reducing sugars (DNSA method) and Proteins (Biuret method)
4. Qualitative analysis of urine for abnormal constituents
5. Determination of blood creatinine
6. Determination of blood sugar
7. Determination of serum total cholesterol
8. Preparation of buffer solution and measurement of pH
9. Study of enzymatic hydrolysis of starch
10. Determination of Salivary amylase activity
11. Study the effect of Temperature on Salivary amylase activity.
12. Study the effect of substrate concentration on salivary amylase activity.

Recommended Books (Latest Editions)

1. Principles of Biochemistry by Lehninger.
2. Harper's Biochemistry by Robert K. Murry, Daryl K. Granner and Victor W. Rodwell.
3. Biochemistry by Stryer.
4. Biochemistry by D. Satyanarayan and U.Chakrapani
5. Textbook of Biochemistry by Rama Rao.
6. Textbook of Biochemistry by Deb.
7. Outlines of Biochemistry by Conn and Stumpf
8. Practical Biochemistry by R.C. Gupta and S. Bhargavan.
9. Introduction of Practical Biochemistry by David T. Plummer. (3rd Edition)
10. Practical Biochemistry for Medical students by Rajagopal and Ramakrishna.
11. Practical Biochemistry by Harold Varley.

BP 204T.PATHOPHYSIOLOGY (THEORY)

45Hours

Scope: Pathophysiology is the study of causes of diseases and reactions of the body to such disease producing causes.This course is designed to impart a thorough knowledge of the relevant aspects of pathology of various conditions with reference to its pharmacological applications, and understanding of basic pathophysiological mechanisms. Hence it will not only help to study the syllabus of pathology, but also to get baseline knowledge required to practice medicine safely, confidently, rationally and effectively.

Objectives: Upon completion of the subject student shall be able to –

1. Describe the etiology and pathogenesis of the selected disease states;
2. Name the signs and symptoms of the diseases; and
3. Mention the complications of the diseases.

Course content:

Unit I **10Hours**

- **Basic principles of Cell injury and Adaptation:**
  Introduction, definitions, Homeostasis, Components and Types of Feedback systems, Causes of cellular injury**,**Pathogenesis (Cell membrane damage, Mitochondrial damage, Ribosome damage, Nuclear damage)**,**Morphology of cell injury – Adaptive changes (Atrophy, Hypertrophy, hyperplasia, Metaplasia, Dysplasia)**,**Cell swelling, Intra cellular accumulation, Calcification, Enzyme leakage and Cell Death Acidosis &Alkalosis,Electrolyte imbalance

- **Basic mechanism involved in the process of inflammation and repair:**
  Introduction, Clinical signs of inflammation, Different types of Inflammation,Mechanism of Inflammation – Alteration in vascular permeability and blood flow, migration of WBC's,Mediators of inflammation,Basic principles of wound healing in the skin,Pathophysiology of Atherosclerosis

Unit II **10Hours**

- **Cardiovascular System:**
  Hypertension, congestive heart failure, ischemic heart disease (angina,myocardial infarction, atherosclerosis and arteriosclerosis)
- **Respiratory system:**Asthma, Chronic obstructive airways diseases.
- **Renal system:**Acute and chronic renal failure .

Unit II **10Hours**

- **Haematological Diseases:**
  Iron deficiency, megaloblastic anemia (Vit B12 and folic acid), sickle cell anemia, thalasemia, hereditary acquired anemia, hemophilia
- **Endocrine system:** Diabetes, thyroid diseases, disorders of sex hormones
- **Nervous system:** Epilepsy, Parkinson's disease, stroke, psychiatric disorders: depression, schizophrenia and Alzheimer's disease.
- **Gastrointestinal system:** Peptic Ulcer
-

Unit IV **8 Hours**

- Inflammatory bowel diseases, jaundice, hepatitis (A,B,C,D,E,F) alcoholic liver disease.
- **Disease of bones and joints:** Rheumatoid arthritis, osteoporosis and gout
- **Principles of cancer:** classification, etiology and pathogenesis of cancer
- **Diseases of bones and joints:**Rheumatoid Arthritis, Osteoporosis,Gout

- **Principles of Cancer:** Classification, etiology and pathogenesis of Cancer

Unit V **7 Hours**

- **Infectious diseases:**Meningitis,Typhoid, Leprosy, Tuberculosis

Urinary tract infections

- **Sexually transmitted diseases:**AIDS, Syphilis, Gonorrhea

Recommended Books (Latest Editions)

1. Vinay Kumar, Abul K. Abas, Jon C. Aster; Robbins &Cotran Pathologic Basis of Disease; South Asia edition; India; Elsevier; 2014.
2. Harsh Mohan; Text book of Pathology; 6th edition; India; Jaypee Publications; 2010.
3. Laurence B, Bruce C, Bjorn K. ; Goodman Gilman's The Pharmacological Basis of Therapeutics; 12th edition; New York; McGraw-Hill; 2011.
4. Best, Charles Herbert 1899-1978; Taylor, Norman Burke 1885-1972; West, John B (John Burnard); Best and Taylor's Physiological basis of medical practice; 12th ed; united states;
5. William and Wilkins, Baltimore;1991 [1990 printing].
6. Nicki R. Colledge, Brian R. Walker, Stuart H. Ralston;Davidson's Principles and Practice of Medicine; 21st edition; London; ELBS/Churchill Livingstone; 2010.
7. Guyton A, John .E Hall; Textbook of Medical Physiology; 12th edition; WB Saunders Company; 2010.
8. Joseph DiPiro, Robert L. Talbert, Gary Yee, Barbara Wells, L. Michael Posey; Pharmacotherapy: A Pathophysiological Approach; 9th edition; London; McGraw-Hill Medical; 2014.
9. V. Kumar, R. S. Cotran and S. L. Robbins; Basic Pathology; 6th edition; Philadelphia; WB Saunders Company; 1997.
10. Roger Walker, Clive Edwards; Clinical Pharmacy and Therapeutics; 3rd edition; London; Churchill Livingstone publication; 2003.

Recommended Journals

1. The Journal of Pathology. ISSN: 1096-9896 (Online)
2. The American Journal of Pathology. ISSN: 0002-9440
3. Pathology. 1465-3931 (Online)
4. International Journal of Physiology, Pathophysiology and Pharmacology. ISSN: 1944-8171 (Online)
5. Indian Journal of Pathology and Microbiology. ISSN-0377-4929.

BP205 T. COMPUTER APPLICATIONS IN PHARMACY (Theory)

30 Hrs (2 Hrs/Week)

Scope: This subject deals with the introduction Database, Database Management system, computer application in clinical studies and use of databases.

Objectives: Upon completion of the course the student shall be able to

1. know the various types of application of computers in pharmacy
2. know the various types of databases
3. know the various applications of databases in pharmacy

Course content:

UNIT – I **06 hours**

Number system: Binary number system, Decimal number system, Octal number system, Hexadecimal number systems, conversion decimal to binary, binary to decimal, octal to binary etc, binary addition, binary subtraction – One's complement ,Two's complement method, binary multiplication, binary division

Concept of I nformation Systems and Software : Information gathering, requirement and feasibility analysis, data flow diagrams, process specifications, input/output design, process life cycle, planning and managing the project

UNIT –II **06 hours**

Web technologies:Introduction to HTML, XML,CSS and Programming languages, introduction to web servers and Server Products

Introduction to databases, MYSQL, MS ACCESS, Pharmacy Drug database

UNIT – III **06 hours**

Application of computers in Pharmacy – Drug information storage and retrieval, Pharmacokinetics, Mathematical model in Drug design, Hospital and Clinical Pharmacy, Electronic Prescribing and discharge (EP) systems, barcode medicine identification and automated dispensing of drugs, mobile technology and adherence monitoring

Diagnostic System, Lab-diagnostic System, Patient Monitoring System, Pharma Information System

UNIT – IV **06 hours**

Bioinformatics: Introduction, Objective of Bioinformatics, Bioinformatics Databases, Concept of Bioinformatics, Impact of Bioinformatics in Vaccine Discovery

UNIT-V **06 hours**

Computers as data analysis in Preclinical development:
Chromatographic dada analysis(CDS), Laboratory Information management System (LIMS) and Text Information Management System(TIMS)

BP210P. COMPUTER APPLICATIONS IN PHARMACY (Practical)

1. Design a questionnaire using a word processing package to gather information about a particular disease.
2. Create a HTML web page to show personal information.
3 Retrieve the information of a drug and its adverse effects using online tools
4 Creating mailing labels Using Label Wizard , generating label in MS WORD
5 Create a database in MS Access to store the patient information with the required fields Using access
6. Design a form in MS Access to view, add, delete and modify the patient record in the database
7. Generating report and printing the report from patient database
8. Creating invoice table using – MS Access
9. Drug information storage and retrieval using MS Access
10. Creating and working with queries in MS Access
11. Exporting Tables, Queries, Forms and Reports to web pages
12. Exporting Tables, Queries, Forms and Reports to XML pages

Recommended books (Latest edition):

1. Computer Application in Pharmacy – William E.Fassett –Lea and Febiger, 600 South Washington Square, USA, (215) 922-1330.
2. Computer Application in Pharmaceutical Research and Development –Sean Ekins – Wiley-Interscience, A John Willey and Sons, INC., Publication, USA
3. Bioinformatics (Concept, Skills and Applications) – S.C.Rastogi-CBS Publishers and Distributors, 4596/1- A, 11 Darya Gani, New Delhi – 110 002(INDIA)
4. Microsoft office Access - 2003, Application Development Using VBA, SQL Server, DAP and Infopath – Cary N.Prague – Wiley Dreamtech India (P) Ltd., 4435/7, Ansari Road, Daryagani, New Delhi - 110002

BP 206 T. ENVIRONMENTAL SCIENCES (Theory)

30 hours

Scope: Environmental Sciences is the scientific study of the environmental system and the status of its inherent or induced changes on organisms. It includes not only the study of physical and biological characters of the environment but also the social and cultural factors and the impact of man on environment.

Objectives: Upon completion of the course the student shall be able to**:**

1. Create the awareness about environmental problems among learners.
2. Impart basic knowledge about the environment and its allied problems.
3. Develop an attitude of concern for the environment.
4. Motivate learner to participate in environment protection and environment improvement.
5. Acquire skills to help the concerned individuals in identifying and solving environmental problems.
6. Strive to attain harmony with Nature.

Course content:

Unit-I **10hours**

The Multidisciplinary nature of environmental studies

Natural Resources

Renewable and non-renewable resources:

Natural resources and associated problems

a) Forest resources; b) Water resources; c) Mineral resources; d) Food resources; e) Energy resources; f) Land resources: Role of an individual in conservation of natural resources.

Unit-II **10hours**

Ecosystems

- Concept of an ecosystem.
- Structure and function of an ecosystem.
- Introduction, types, characteristic features, structure and function of the ecosystems: Forest ecosystem; Grassland ecosystem; Desert ecosystem; Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Unit- III **10hours**

Environmental Pollution: Air pollution; Water pollution; Soil pollution

Recommended Books (Latest edition):

1. Y.K. Sing, Environmental Science, New Age International Pvt, Publishers, Bangalore
2. Agarwal, K.C. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.
3. Bharucha Erach, The Biodiversity of India, Mapin Pu blishing Pvt. Ltd., Ahmedabad – 380 013, India,
4. Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480p
5. Clark R.S., Marine Pollution, Clanderson Press Oxford
6. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Publ. House, Mumbai, 1196p
7. De A.K., Environmental Chemistry, Wiley Eastern Ltd.
8. Down of Earth, Centre for Science and Environment

SEMESTER III

BP301T. PHARMACEUTICAL ORGANIC CHEMISTRY –II (Theory)

45 Hours

Scope: This subject deals with general methods of preparation and reactions of some organic compounds. Reactivity of organic compounds are also studied here. The syllabus emphasizes on mechanisms and orientation of reactions. Chemistry of fats and oils are also included in the syllabus.

Objectives: Upon completion of the course the student shall be able to

1. write the structure, name and the type of isomerism of the organic compound
2. write the reaction, name the reaction and orientation of reactions
3. account for reactivity/stability of compounds,
4. prepare organic compounds

Course Content:

General methods of preparation and reactions of compounds superscripted with asterisk (*) to be explained

To emphasize on definition, types, classification, principles/mechanisms, applications, examples and differences

UNIT I **10 Hours**

- **Benzene and its derivatives**
  - **A.** Analytical, synthetic and other evidences in the derivation of structure of benzene, Orbital picture, resonance in benzene, aromatic characters, Huckel's rule
  - **B.** Reactions of benzene - nitration, sulphonation, halogenation-reactivity, Friedelcrafts alkylation- reactivity, limitations, Friedelcrafts acylation.
  - **C.** Substituents, effect of substituents on reactivity and orientation of mono substituted benzene compounds towards electrophilic substitution reaction
  - **D.** Structure and uses of DDT, Saccharin, BHC and Chloramine

UNIT II **10 Hours**

- **Phenols*** - Acidity of phenols, effect of substituents on acidity, qualitative tests, Structure and uses of phenol, cresols, resorcinol, naphthols
- **Aromatic Amines* -** Basicity of amines, effect of substituents on basicity, and synthetic uses of aryl diazonium salts
- **Aromatic Acids* –**Acidity, effect of substituents on acidity and important reactions of benzoic acid.

UNIT III

10 Hours

- **Fats and Oils**

a. Fatty acids – reactions.

b. Hydrolysis, Hydrogenation, Saponification and Rancidity of oils, Drying oils.

c. Analytical constants – Acid value, Saponification value, Ester value, Iodine value, Acetyl value, Reichert Meissl (RM) value – significance and principle involved in their determination.

UNIT IV **08 Hours**

- **Polynuclear hydrocarbons:**

a. Synthesis, reactions

b. Structure and medicinal uses of Naphthalene, Phenanthrene, Anthracene, Diphenylmethane, Triphenylmethane and their derivatives

UNIT V **07 Hours**

- **Cyclo alkanes***

Stabilities – Baeyer's strain theory, limitation of Baeyer's strain theory, Coulson and Moffitt's modification, Sachse Mohr's theory (Theory of strainless rings), reactions of cyclopropane and cyclobutane only

BP305P. PHARMACEUTICAL ORGANIC CHEMISTRY -II (Practical)

4 Hrs/week

I Experiments involving laboratory techniques

- Recrystallization
- Steam distillation

II Determination of following oil values (including standardization of reagents)

- Acid value
- Saponification value
- Iodine value

III **Preparation of compounds**

- Benzanilide/Phenyl benzoate/Acetanilide from Aniline/ Phenol /Aniline by acylation reaction.
- 2,4,6-Tribromo aniline/Para bromo acetanilide from Aniline/
- Acetanilide by halogenation (Bromination) reaction.
- 5-Nitro salicylic acid/Meta di nitro benzene from Salicylic acid / Nitro benzene by nitration reaction.
- Benzoic acid from Benzyl chloride by oxidation reaction.
- Benzoic acid/ Salicylic acid from alkyl benzoate/ alkyl salicylate by hydrolysis reaction.
- 1-Phenyl azo-2-napthol from Aniline by diazotization and coupling reactions.
- Benzil from Benzoin by oxidation reaction.
- Dibenzal acetone from Benzaldehyde by Claison Schmidt reaction
- Cinnammic acid from Benzaldehyde by Perkin reaction
- *P*-Iodo benzoic acid from *P*-amino benzoic acid

Recommended Books (Latest Editions)

1. Organic Chemistry by Morrison and Boyd
2. Organic Chemistry by I.L. Finar , Volume-I
3. Textbook of Organic Chemistry by B.S. Bahl & Arun Bahl.
4. Organic Chemistry by P.L.Soni
5. Practical Organic Chemistry by Mann and Saunders.
6. Vogel's text book of Practical Organic Chemistry
7. Advanced Practical organic chemistry by N.K.Vishnoi.

8. Introduction to Organic Laboratory techniques by Pavia, Lampman and Kriz.

BP302T. PHYSICAL PHARMACEUTICS-I (Theory)

45Hours

Scope: The course deals with the various physica and physicochemical properties, and principles involved in dosage forms/formulations. Theory and practical components of the subject help the student to get a better insight into various areas of formulation research and development, and stability studies of pharmaceutical dosage forms.

Objectives: Upon the completion of the course student shall be able to

1. Understand various physicochemical properties of drug molecules in the designing the dosage forms
2. Know the principles of chemical kinetics & to use them for stability testing nad determination of expiry date of formulations
3. Demonstrate use of physicochemical properties in the formulation development and evaluation of dosage forms.

Course Content:

UNIT-I **10 Hours**

Solubility of drugs: Solubility expressions, mechanisms of solute solvent interactions, ideal solubility parameters, solvation & association, quantitative approach to the factors influencing solubility of drugs, diffusion principles in biological systems. Solubility of gas in liquids, solubility of liquids in liquids, (Binary solutions, ideal solutions) Raoult's law, real solutions. Partially miscible liquids, Critical solution temperature and applications. Distribution law, its limitations and applications

UNIT-II **10Hours**

States of Matter and properties of matter: State of matter, changes in the state of matter, latent heats, vapour pressure, sublimation critical point, eutectic mixtures, gases, aerosols – inhalers, relative humidity, liquid complexes, liquid crystals, glassy states, solid-crystalline, amorphous & polymorphism.

Physicochemical properties of drug molecules: Refractive index, optical rotation, dielectric constant, dipole moment, dissociation constant, determinations and applications

UNIT-III **08 Hours**

Surface and interfacial phenomenon: Liquid interface, surface & interfacial tensions,

surface free energy, measurement of surface & interfacial tensions, spreading coefficient, adsorption at liquid interfaces, surface active agents, HLB Scale, solubilisation, detergency, adsorption at solid interface.

UNIT-IV **08Hours**

Complexation and protein binding: Introduction, Classification of Complexation, Applications, methods of analysis, protein binding, Complexation and drug action, crystalline structures of complexes and thermodynamic treatment of stability constants.

UNIT-V **07 Hours**

pH, buffers and Isotonic solutions: Sorensen's pH scale, pH determination (electrometric and calorimetric), applications of buffers, buffer equation, buffer capacity, buffers in pharmaceutical and biological systems, buffered isotonic solutions.

BP306P. PHYSICAL PHARMACEUTICS – I (Practical)

4 Hrs/week

1. Determination the solubility of drug at room temperature
2. Determination of pKa value by Half Neutralization/ Henderson Hasselbalch equation.
3. Determination of Partition co- efficient of benzoic acid in benzene and water
4. Determination of Partition co- efficient of Iodine in CCl_4 and water
5. Determination of % composition of NaCl in a solution using phenol-water system by CST method
6. Determination of surface tension of given liquids by drop count and drop weight method
7. Determination of HLB number of a surfactant by saponification method
8. Determination of Freundlich and Langmuir constants using activated char coal
9. Determination of critical micellar concentration of surfactants
10. Determination of stability constant and donor acceptor ratio of PABA-Caffeine complex by solubility method
11. Determination of stability constant and donor acceptor ratio of Cupric-Glycine complex by pH titration method

Recommended Books: (Latest Editions)

1. Physical Pharmacy by Alfred Martin
2. Experimental Pharmaceutics by Eugene, Parott.
3. Tutorial Pharmacy by Cooper and Gunn.
4. Stocklosam J. Pharmaceutical Calculations, Lea &Febiger, Philadelphia.
5. Liberman H.A, Lachman C., Pharmaceutical Dosage forms, Tablets, Volume-1 to 3, MarcelDekkar Inc.
6. Liberman H.A, Lachman C, Pharmaceutical Dosage forms. Disperse systems, volume 1, 2, 3. Marcel Dekkar Inc.
7. Physical Pharmaceutics by Ramasamy C and ManavalanR.
8. Laboratory Manual of Physical Pharmaceutics, C.V.S. Subramanyam, J. Thimma settee
9. Physical Pharmaceutics by C.V.S. Subramanyam
10. Test book of Physical Phramacy, by Gaurav Jain & Roop K. Khar

BP 303 T. PHARMACEUTICAL MICROBIOLOGY (Theory)

45Hours

Scope:

- Study of all categories of microorganisims especially for the production of alchol antibiotics, vaccines, vitamins enzymes etc..

Objectives: Upon completion of the subject student shall be able to;

1. Understand methods of identification, cultivation and preservation of various microorganisms
2. To understand the importance and implementation of sterlization in pharmaceutical processing and industry
3. Learn sterility testing of pharmaceutical products.
4. Carried out microbiological standardization of Pharmaceuticals.
5. Understand the cell culture technology and its applications in pharmaceutical industries.

Course content:

Unit I **10 Hours**

Introduction, history of microbiology, its branches, scope and its importance.
Introduction to Prokaryotes and Eukaryotes
Study of ultra-structure and morphological classification of bacteria, nutritional requirements, raw materials used for culture media and physical parameters for growth, growth curve, isolation and preservation methods for pure cultures, cultivation of anaerobes, quantitative measurement of bacterial growth (total & viable count).
Study of different types of phase constrast microscopy, dark field microscopy and electron microscopy.

Unit II **10 Hours**

Identification of bacteria using staining techniques (simple, Gram's &Acid fast staining) and biochemical tests (IMViC).

Study of principle, procedure, merits, demerits and applications of physical, chemical gaseous,radiation and mechanical method of sterilization.

Evaluation of the efficiency of sterilization methods.

Equipments employed in large scale sterilization.

Sterility indicators.

Unit III **10 Hours**

Study of morphology, classification, reproduction/replication and cultivation of Fungi and Viruses.

Classification and mode of action of disinfectants

Factors influencing disinfection, antiseptics and their evaluation. For bacteriostatic and bactericidal actions

Evaluation of bactericidal & Bacteriostatic.

Sterility testing of products (solids, liquids, ophthalmic and other sterile products) according to IP, BP and USP.

Unit IV **08 Hours**

Designing of aseptic area, laminar flow equipments; study of different sources of contamination in an aseptic area and methods of prevention, clean area classification.
Principles and methods of different microbiological assay. Methods for standardization of antibiotics, vitamins and amino acids.
Assessment of a new antibiotic.

Unit V **07Hours**

Types of spoilage, factors affecting the microbial spoilage of pharmaceutical products, sources and types of microbial contaminants, assessment of microbial contamination and spoilage.

Preservation of pharmaceutical products using antimicrobial agents, evaluation of microbial stability of formulations.

Growth of animal cells in culture, general procedure for cell culture, Primary, established and transformed cell cultures.

Application of cell cultures in pharmaceutical industry and research.

BP 307P.PHARMACEUTICAL MICROBIOLOGY (Practical)

4 Hrs/week

1. Introduction and study of different equipments and processing, e.g., B.O.D. incubator, laminar flow, aseptic hood, autoclave, hot air sterilizer, deep freezer, refrigerator, microscopes used in experimental microbiology.
2. Sterilization of glassware, preparation and sterilization of media.
3. Sub culturing of bacteria and fungus. Nutrient stabs and slants preparations.
4. Staining methods- Simple, Grams staining and acid fast staining (Demonstration with practical).
5. Isolation of pure culture of micro-organisms by multiple streak plate technique and other techniques.
6. Microbiological assay of antibiotics by cup plate method and other methods
7. Motility determination by Hanging drop method.
8. Sterility testing of pharmaceuticals.
9. Bacteriological analysis of water
10. Biochemical test.

Recommended Books (Latest edition)

1. W.B. Hugo and A.D. Russel: Pharmaceutical Microbiology, Blackwell Scientific publications, Oxford London.
2. Prescott and Dunn., Industrial Microbiology, 4th edition, CBS Publishers & Distributors, Delhi.
3. Pelczar, Chan Kreig, Microbiology, Tata McGraw Hill edn.
4. Malcolm Harris, Balliere Tindall and Cox: Pharmaceutical Microbiology.
5. Rose: Industrial Microbiology.
6. Probisher, Hinsdill et al: Fundamentals of Microbiology, 9th ed. Japan
7. Cooper and Gunn's: Tutorial Pharmacy, CBS Publisher and Distribution.
8. Peppler: Microbial Technology.
9. I.P., B.P., U.S.P.- latest editions.
10. Ananthnarayan : Text Book of Microbiology, Orient-Longman, Chennai
11. Edward: Fundamentals of Microbiology.
12. N.K.Jain: Pharmaceutical Microbiology, Vallabh Prakashan, Delhi
13. Bergeys manual of systematic bacteriology, Williams and Wilkins- A Waverly company

BP 304 T. PHARMACEUTICAL ENGINEERING (Theory)

45 Hours

Scope: This course is designed to impart a fundamental knowledge on the art and science of various unit operations used in pharmaceutical industry.

Objectives: Upon completion of the course student shall be able:

1. To know various unit operations used in Pharmaceutical industries.
2. To understand the material handling techniques.
3. To perform various processes involved in pharmaceutical manufacturing process.
4. To carry out various test to prevent environmental pollution.
5. To appreciate and comprehend significance of plant lay out design for optimum use of resources.
6. To appreciate the various preventive methods used for corrosion control in Pharmaceutical industries.

Course content:

UNIT-I **10 Hours**

- **Flow of fluids:** Types of manometers, Reynolds number and its significance, Bernoulli's theorem and its applications, Energy losses, Orifice meter, Venturimeter, Pitot tube and Rotometer.
- **Size Reduction:** Objectives, Mechanisms & Laws governing size reduction, factors affecting size reduction, principles, construction, working, uses, merits and demerits of Hammer mill, ball mill, fluid energy mill, Edge runner mill & end runner mill.
- **Size Separation:** Objectives, applications & mechanism of size separation, official standards of powders, sieves, size separation Principles, construction, working, uses, merits and demerits of Sieve shaker, cyclone separator, Air separator, Bag filter & elutriation tank.

UNIT-II **10 Hours**

- **Heat Transfer:** Objectives, applications & Heat transfer mechanisms. Fourier's law, Heat transfer by conduction, convection & radiation. Heat interchangers & heat exchangers.

- **Evaporation:** Objectives, applications and factors influencing evaporation, differences between evaporation and other heat process. principles, construction, working, uses, merits and demerits of Steam jacketed kettle, horizontal tube evaporator, climbing film evaporator, forced circulation evaporator, multiple effect evaporator& Economy of multiple effect evaporator.

- **Distillation:** Basic Principles and methodology of simple distillation,flash distillation, fractional distillation, distillation under reduced pressure, steam distillation & molecular distillation

UNIT- III **08 Hours**

- **Drying:** Objectives, applications & mechanism of drying process, measurements & applications of Equilibrium Moisture content, rate of drying curve. principles, construction, working, uses, merits and demerits of Tray dryer, drum dryer spray dryer, fluidized bed dryer, vacuum dryer, freeze dryer.

- **Mixing:** Objectives, applications & factors affecting mixing, Difference between solid and liquid mixing, mechanism of solid mixing, liquids mixing and semisolids mixing. Principles, Construction, Working, uses, Merits and Demerits of Double cone blender, twin shell blender, ribbon blender, Sigma blade mixer, planetary mixers, Propellers, Turbines, Paddles & Silverson Emulsifier,

UNIT-IV **08 Hours**

- **Filtration:** Objectives, applications, Theories & Factors influencing filtration, filter aids, filter medias. Principle, Construction, Working, Uses, Merits and demerits of plate & frame filter, filter leaf, rotary drum filter, Meta filter & Cartridge filter, membrane filters and Seidtz filter.
- **Centrifugation:** Objectives, principle & applications of Centrifugation, principles, construction, working, uses, merits and demerits of Perforated basket centrifuge, Non-perforated basket centrifuge, semi continuous centrifuge & super centrifuge.

UNIT- V **07 Hours**

- **Materials of pharmaceutical plant construction, Corrosion and its prevention:** Factors affecting during materials selected for Pharmaceutical plant construction, Theories of corrosion, types of corrosion and there prevention. Ferrous and nonferrous metals, inorganic and organic non metals, basic of material handling systems.

Recommended Books: (Latest Editions)

1. Introduction to chemical engineering – Walter L Badger & Julius Banchero, Latest edition.
2. Solid phase extraction, Principles, techniques and applications by Nigel J.K. Simpson- Latest edition.
3. Unit operation of chemical engineering – Mcabe Smith, Latest edition.
4. Pharmaceutical engineering principles and practices – C.V.S Subrahmanyam et al., Latest edition.
5. Remington practice of pharmacy- Martin, Latest edition.
6. Theory and practice of industrial pharmacy by Lachmann., Latest edition.
7. Physical pharmaceutics- C.V.S Subrahmanyam et al., Latest edition.
8. Cooper and Gunn's Tutorial pharmacy, S.J. Carter, Latest edition.

BP308P - PHARMACEUTICAL ENGINEERING (Practical)

4 Hours/week

I. Determination of radiation constant of brass, iron, unpainted and painted glass.
II. Steam distillation – To calculate the efficiency of steam distillation.
III. To determine the overall heat transfer coefficient by heat exchanger.
IV. Construction of drying curves (for calcium carbonate and starch).
V. Determination of moisture content and loss on drying.
VI. Determination of humidity of air – i) From wet and dry bulb temperatures –use of Dew point method.
VII. Description of Construction working and application of Pharmaceutical Machinery such as rotary tablet machine, fluidized bed coater, fluid energy mill, de humidifier.
VIII. Size analysis by sieving – To evaluate size distribution of tablet granulations – Construction of various size frequency curves including arithmetic andlogarithmic probability plots.
IX. Size reduction: To verify the laws of size reduction using ball mill and determining Kicks, Rittinger's, Bond's coefficients, power requirement and critical speed of Ball Mill.
X. Demonstration of colloid mill, planetary mixer, fluidized bed dryer, freeze dryer and such othermajor equipment.
XI. Factors affecting Rate of Filtration and Evaporation (Surface area, Concentration and Thickness/ viscosity
XII. To study the effect of time on the Rate of Crystallization.
XIII. To calculate the uniformity Index for given sample by using Double Cone Blender.

SEMESTER IV

BP401T. PHARMACEUTICAL ORGANIC CHEMISTRY –III (Theory)

45 Hours

Scope: This subject imparts knowledge on stereo-chemical aspects of organic compounds and organic reactions, important named reactions, chemistry of important hetero cyclic compounds. It also emphasizes on medicinal and other uses of organic compounds.

Objectives: At the end of the course, the student shall be able to

1. understand the methods of preparation and properties of organic compounds
2. explain the stereo chemical aspects of organic compounds and stereo chemical reactions
3. know the medicinal uses and other applications of organic compounds

Course Content:

Note: To emphasize on definition, types, mechanisms, examples, uses/applications

UNIT-I **10 Hours**

Stereo isomerism

Optical isomerism –

Optical activity, enantiomerism, diastereoisomerism, meso compounds

Elements of symmetry, chiral and achiral molecules

DL system of nomenclature of optical isomers, sequence rules, RS system of nomenclature of optical isomers

Reactions of chiral molecules

Racemic modification and resolution of racemic mixture.

Asymmetric synthesis: partial and absolute

UNIT-II **10 Hours**

Geometrical isomerism

Nomenclature of geometrical isomers (Cis Trans, EZ, Syn Anti systems)

Methods of determination of configuration of geometrical isomers.

Conformational isomerism in Ethane, n-Butane and Cyclohexane.

Stereo isomerism in biphenyl compounds (Atropisomerism) and conditions for optical activity.

Stereospecific and stereoselective reactions

UNIT-III **10 Hours**

Heterocyclic compounds:

Nomenclature and classification

Synthesis, reactions and medicinal uses of following compounds/derivatives

Pyrrole, Furan, and Thiophene

Relative aromaticity and reactivity of Pyrrole, Furan and Thiophene

UNIT-IV **8 Hours**

Synthesis, reactions and medicinal uses of following compounds/derivatives

Pyrazole, Imidazole, Oxazole and Thiazole.

Pyridine, Quinoline, Isoquinoline, Acridine and Indole. Basicity of pyridine

Synthesis and medicinal uses of Pyrimidine, Purine, azepines and their derivatives

UNIT-V **07 Hours**

Reactions of synthetic importance

Metal hydride reduction ($NaBH_4$ and $LiAlH_4$), Clemmensen reduction, Birch reduction, Wolff Kishner reduction.

Oppenauer-oxidation and Dakin reaction.

Beckmanns rearrangement and Schmidt rearrangement.

Claisen-Schmidt condensation

Recommended Books (Latest Editions)

1. Organic chemistry by I.L. Finar, Volume-I & II.
2. A text book of organic chemistry – Arun Bahl, B.S. Bahl.
3. Heterocyclic Chemistry by Raj K. Bansal
4. Organic Chemistry by Morrison and Boyd
5. Heterocyclic Chemistry by T.L. Gilchrist

BP402T. MEDICINAL CHEMISTRY – I (Theory)

45 Hours

Scope: This subject is designed to impart fundamental knowledge on the structure, chemistry and therapeutic value of drugs. The subject emphasizes on structure activity relationships of drugs, importance of physicochemical properties and metabolism of drugs. The syllabus also emphasizes on chemical synthesis of important drugs under each class.

Objectives: Upon completion of the course the student shall be able to

1. understand the chemistry of drugs with respect to their pharmacological activity
2. understand the drug metabolic pathways, adverse effect and therapeutic value of drugs
3. know the Structural Activity Relationship (SAR) of different class of drugs
4. write the chemical synthesis of some drugs

Course Content:

Study of the development of the following classes of drugs, Classification, mechanism of action, uses of drugs mentioned in the course, Structure activity relationship of selective class of drugs as specified in the course and synthesis of drugs superscripted (*)

UNIT- I **10 Hours**

Introduction to Medicinal Chemistry

History and development of medicinal chemistry

Physicochemical properties in relation to biological action

Ionization, Solubility, Partition Coefficient, Hydrogen bonding, Protein binding, Chelation, Bioisosterism, Optical and Geometrical isomerism.

Drug metabolism

Drug metabolism principles- Phase I and Phase II.

Factors affecting drug metabolism including stereo chemical aspects.

UNIT- II **10 Hours**

Drugs acting on Autonomic Nervous System

Adrenergic Neurotransmitters:

Biosynthesis and catabolism of catecholamine.

Adrenergic receptors (Alpha & Beta) and their distribution.

Sympathomimetic agents: SAR of Sympathomimetic agents

Direct acting: Nor-epinephrine, Epinephrine, Phenylephrine*, Dopamine,

Methyldopa, Clonidine, Dobutamine, Isoproterenol, Terbutaline, Salbutamol*, Bitolterol, Naphazoline, Oxymetazoline and Xylometazoline.

- Indirect acting agents: Hydroxyamphetamine, Pseudoephedrine, Propylhexedrine.
- Agents with mixed mechanism: Ephedrine, Metaraminol.

Adrenergic Antagonists:

Alpha adrenergic blockers: Tolazoline*, Phentolamine, Phenoxybenzamine, Prazosin, Dihydroergotamine, Methysergide.

Beta adrenergic blockers: SAR of beta blockers, Propranolol*, Metibranolol, Atenolol, Betazolol, Bisoprolol, Esmolol, Metoprolol, Labetolol, Carvedilol.

UNIT-III **10 Hours**

Cholinergic neurotransmitters:

Biosynthesis and catabolism of acetylcholine.

Cholinergic receptors (Muscarinic & Nicotinic) and their distribution.

Parasympathomimetic agents: SAR of Parasympathomimetic agents

Direct acting agents: Acetylcholine, Carbachol*, Bethanechol, Methacholine, Pilocarpine.

Indirect acting/ Cholinesterase inhibitors (Reversible & Irreversible): Physostigmine, Neostigmine*, Pyridostigmine, Edrophonium chloride, Tacrine hydrochloride, Ambenonium chloride, Isofluorphate, Echothiophate iodide, Parathione, Malathion.

Cholinesterase reactivator: Pralidoxime chloride.

Cholinergic Blocking agents: SAR of cholinolytic agents

Solanaceous alkaloids and analogues: Atropine sulphate, Hyoscyamine sulphate, Scopolamine hydrobromide, Homatropine hydrobromide, Ipratropium bromide*.

Synthetic cholinergic blocking agents: Tropicamide, Cyclopentolate hydrochloride, Clidinium bromide, Dicyclomine hydrochloride*, Glycopyrrolate, Methantheline bromide, Propantheline bromide, Benztropine mesylate, Orphenadrine citrate, Biperidine hydrochloride, Procyclidine hydrochloride*, Tridihexethyl chloride, Isopropamide iodide, Ethopropazine hydrochloride.

UNIT- IV **08 Hours**

Drugs acting on Central Nervous System

A. Sedatives and Hypnotics:

Benzodiazepines: SAR of Benzodiazepines, Chlordiazepoxide, Diazepam*, Oxazepam, Chlorazepate, Lorazepam, Alprazolam, Zolpidem

Barbiturtes: SAR of barbiturates, Barbital*, Phenobarbital, Mephobarbital, Amobarbital, Butabarbital, Pentobarbital, Secobarbital

Miscelleneous:

Amides & imides: Glutethmide.

Alcohol & their carbamate derivatives: Meprobomate, Ethchlorvynol.

Aldehyde & their derivatives: Triclofos sodium, Paraldehyde.

B. Antipsychotics

Phenothiazeines: SAR of Phenothiazeines - Promazine hydrochloride, Chlorpromazine hydrochloride*, Trifluprомazine, Thioridazine hydrochloride, Piperacetazine hydrochloride, Prochlorperazine maleate, Trifluoperazine hydrochloride.

Ring Analogues of Phenothiazeines: Chlorprothixene, Thiothixene, Loxapine succinate, Clozapine.

Fluro buterophenones: Haloperidol, Droperidol, Risperidone.

Beta amino ketones: Molindone hydrochloride.

Benzamides: Sulpieride.

C. Anticonvulsants: SAR of Anticonvulsants**,** mechanism of anticonvulsant action

Barbiturates: Phenobarbitone, Methabarbital. **Hydantoins:**

Phenytoin*, Mephenytoin, Ethotoin **Oxazolidine diones:**

Trimethadione, Paramethadione **Succinimides:**

Phensuximide, Methsuximide, Ethosuximide* **Urea and**

monoacylureas: Phenacemide, Carbamazepine*

Benzodiazepines: Clonazepam

Miscellaneous: Primidone, Valproic acid , Gabapentin, Felbamate

UNIT – V **07 Hours**

Drugs acting on Central Nervous System

General anesthetics:

Inhalation anesthetics: Halothane*, Methoxyflurane, Enflurane, Sevoflurane, Isoflurane, Desflurane.

Ultra short acting barbitutrates: Methohexital sodium*, Thiamylal sodium, Thiopental sodium.

Dissociative anesthetics: Ketamine hydrochloride.*

Narcotic and non-narcotic analgesics

Morphine and related drugs: SAR of Morphine analogues, Morphine sulphate, Codeine, Meperidine hydrochloride, Anilerdine hydrochloride, Diphenoxylate hydrochloride, Loperamide hydrochloride, Fentanyl citrate*, Methadone hydrochloride*, Propoxyphene hydrochloride, Pentazocine, Levorphanol tartarate.

Narcotic antagonists: Nalorphine hydrochloride, Levallorphan tartarate, Naloxone hydrochloride.

Anti-inflammatory agents: Sodium salicylate, Aspirin, Mefenamic acid*, Meclofenamate, Indomethacin, Sulindac, Tolmetin, Zomepriac, Diclofenac, Ketorolac, Ibuprofen*, Naproxen, Piroxicam, Phenacetin, Acetaminophen, Antipyrine, Phenylbutazone.

BP406P. MEDICINAL CHEMISTRY – I (Practical)

4 Hours/Week

I	**Preparation of drugs/ intermediates**
1	1,3-pyrazole
2	1,3-oxazole
3	Benzimidazole
4	Benztriazole
5	2,3- diphenyl quinoxaline
6	Benzocaine
7	Phenytoin
8	Phenothiazine
9	Barbiturate
II	**Assay of drugs**
1	Chlorpromazine
2	Phenobarbitone
3	Atropine
4	Ibuprofen
5	Aspirin
6	Furosemide
III	**Determination of Partition coefficient for any two drugs**

Recommended Books (Latest Editions)

1. Wilson and Giswold's Organic medicinal and Pharmaceutical Chemistry.
2. Foye's Principles of Medicinal Chemistry.
3. Burger's Medicinal Chemistry, Vol I to IV.
4. Introduction to principles of drug design- Smith and Williams.
5. Remington's Pharmaceutical Sciences.
6. Martindale's extra pharmacopoeia.

7. Organic Chemistry by I.L. Finar, Vol. II.
8. The Organic Chemistry of Drug Synthesis by Lednicer, Vol. 1-5.
9. Indian Pharmacopoeia.
10. Text book of practical organic chemistry- A.I.Vogel.

BP 403 T. PHYSICAL PHARMACEUTICS-II (Theory)

45Hours

Scope: The course deals with the various physica and physicochemical properties, and principles involved in dosage forms/formulations. Theory and practical components of the subject help the student to get a better insight into various areas of formulation research and development, and stability studies of pharmaceutical dosage forms.

Objectives: Upon the completion of the course student shall be able to

1. Understand various physicochemical properties of drug molecules in the designing the dosage forms
2. Know the principles of chemical kinetics & to use them for stability testing nad determination of expiry date of formulations
3. Demonstrate use of physicochemical properties in the formulation development and evaluation of dosage forms.

Course Content:

UNIT-I **07 Hours**

Colloidal dispersions: Classification of dispersed systems & their general characteristics, size & shapes of colloidal particles, classification of colloids & comparative account of their general properties. Optical, kinetic & electrical properties. Effect of electrolytes, coacervation, peptization& protective action.

UNIT-II **10 Hours**

Rheology: Newtonian systems, law of flow, kinematic viscosity, effect of temperature, non-Newtonian systems, pseudoplastic, dilatant, plastic, thixotropy, thixotropy in formulation, determination of viscosity, capillary, falling Sphere, rotational viscometers

Deformation of solids: Plastic and elastic deformation, Heckel equation, Stress, Strain, Elastic Modulus

UNIT-III **10 Hours**

Coarse dispersion: Suspension, interfacial properties of suspended particles, settling in suspensions, formulation of flocculated and deflocculated suspensions. Emulsions and theories of emulsification, microemulsion and multiple emulsions; Stability of emulsions, preservation of emulsions, rheological properties of emulsions and emulsion formulation by HLB method.

UNIT-IV **10Hours**

Micromeretics: Particle size and distribution, mean particle size, number and weight distribution, particle number, methods for determining particle size by different methods, counting and separation method, particle shape, specific surface, methods for determining surface area, permeability, adsorption, derived properties of powders, porosity, packing arrangement, densities, bulkiness & flow properties.

UNIT-V **10 Hours**

Drug stability: Reaction kinetics: zero, pseudo-zero, first & second order, units of basic rate constants, determination of reaction order. Physical and chemical factors influencing the chemical degradation of pharmaceutical product: temperature, solvent, ionic strength, dielectric constant, specific & general acid base catalysis, Simple numerical problems. Stabilization of medicinal agents against common reactions like hydrolysis & oxidation. Accelerated stability testing in expiration dating of pharmaceutical dosage forms. Photolytic degradation and its prevention

BP 407P. PHYSICAL PHARMACEUTICS- II (Practical)

3 Hrs/week

1. Determination of particle size, particle size distribution using sieving method
2. Determination of particle size, particle size distribution using Microscopic method
3. Determination of bulk density, true density and porosity
4. Determine the angle of repose and influence of lubricant on angle of repose
5. Determination of viscosity of liquid using Ostwald's viscometer
6. Determination sedimentation volume with effect of different suspending agent
7. Determination sedimentation volume with effect of different concentration of single suspending agent
8. Determination of viscosity of semisolid by using Brookfield viscometer
9. Determination of reaction rate constant first order.
10. Determination of reaction rate constant second order
11. Accelerated stability studies

Recommended Books: (Latest Editions)

1. Physical Pharmacy by Alfred Martin, Sixth edition
2. Experimental pharmaceutics by Eugene, Parott.
3. Tutorial pharmacy by Cooper and Gunn.
4. Stocklosam J. Pharmaceutical calculations, Lea & Febiger, Philadelphia.
5. Liberman H.A, Lachman C., Pharmaceutical Dosage forms, Tablets, Volume-1 to 3, Marcel Dekkar Inc.
6. Liberman H.A, Lachman C, Pharmaceutical dosage forms. Disperse systems, volume 1, 2, 3. Marcel Dekkar Inc.
7. Physical Pharmaceutics by Ramasamy C, and Manavalan R.

BP 404 T. PHARMACOLOGY-I (Theory)

45 Hrs

Scope: The main purpose of the subject is to understand what drugs do to the living organisms and how their effects can be applied to therapeutics. The subject covers the information about the drugs like, mechanism of action, physiological and biochemical effects (pharmacodynamics) as well as absorption, distribution, metabolism and excretion (pharmacokinetics) along with the adverse effects, clinical uses, interactions, doses, contraindications and routes of administration of different classes of drugs.

Objectives: Upon completion of this course the student should be able to

1. Understand the pharmacological actions of different categories of drugs
2. Explain the mechanism of drug action at organ system/sub cellular/ macromolecular levels.
3. Apply the basic pharmacological knowledge in the prevention and treatment of various diseases.
4. Observe the effect of drugs on animals by simulated experiments
5. Appreciate correlation of pharmacology with other bio medical sciences

Course Content:

UNIT-I **08 hours**

1. General Pharmacology

a. Introduction to Pharmacology- Definition, historical landmarks and scope of pharmacology, nature and source of drugs, essential drugs concept and routes of drug administration, Agonists, antagonists(competitive and non competitive), spare receptors, addiction, tolerance, dependence, tachyphylaxis, idiosyncrasy, allergy.

b. Pharmacokinetics- Membrane transport, absorption, distribution, metabolism and excretion of drugs .Enzyme induction, enzyme inhibition, kinetics of elimination

UNIT-II **12 Hours**

General Pharmacology

a. Pharmacodynamics- Principles and mechanisms of drug action. Receptor theories and classification of receptors, regulation of receptors. drug receptors interactions signal transduction mechanisms, G-protein–coupled receptors, ion channel receptor, transmembrane enzyme linked receptors, transmembrane JAK-STAT binding receptor and receptors that regulate transcription factors, dose response relationship, therapeutic index, combined effects of drugs and factors modifying drug action.
b. Adverse drug reactions.
c. Drug interactions (pharmacokinetic and pharmacodynamic)
d. Drug discovery and clinical evaluation of new drugs -Drug discovery phase, preclinical evaluation phase, clinical trial phase, phases of clinical trials and pharmacovigilance.

UNIT-III **10 Hours**

2. Pharmacology of drugs acting on peripheral nervous system

a. Organization and function of ANS.

b.Neurohumoral transmission,co-transmission and classification of neurotransmitters.

c. Parasympathomimetics, Parasympatholytics, Sympathomimetics, sympatholytics.

d. Neuromuscular blocking agents and skeletal muscle relaxants (peripheral).

e. Local anesthetic agents.

f. Drugs used in myasthenia gravis and glaucoma

UNIT-IV **08 Hours**

3. Pharmacology of drugs acting on central nervous system

a. Neurohumoral transmission in the C.N.S.special emphasis on importance of various neurotransmitters like with GABA, Glutamate, Glycine, serotonin, dopamine.

b. General anesthetics and pre-anesthetics**.**

c. Sedatives, hypnotics and centrally acting muscle relaxants.

d. Anti-epileptics

e. Alcohols and disulfiram

UNIT-V **07 Hours**

3. Pharmacology of drugs acting on central nervous system

a. Psychopharmacological agents: Antipsychotics, antidepressants, anti-anxiety agents, anti-manics and hallucinogens.

b. Drugs used in Parkinsons disease and Alzheimer's disease.

c. CNS stimulants and nootropics.

d. Opioid analgesics and antagonists

e. Drug addiction, drug abuse, tolerance and dependence.

BP 408 P.PHARMACOLOGY-I (Practical)

4Hrs/Week

1. Introduction to experimental pharmacology.
2. Commonly used instruments in experimental pharmacology.
3. Study of common laboratory animals.
4. Maintenance of laboratory animals as per CPCSEA guidelines.
5. Common laboratory techniques. Blood withdrawal, serum and plasma separation, anesthetics and euthanasia used for animal studies.
6. Study of different routes of drugs administration in mice/rats.
7. Study of effect of hepatic microsomal enzyme inducers on the phenobarbitone sleeping time in mice.
8. Effect of drugs on ciliary motility of frog oesophagus
9. Effect of drugs on rabbit eye.
10. Effects of skeletal muscle relaxants using rota-rod apparatus.
11. Effect of drugs on locomotor activity using actophotometer.
12. Anticonvulsant effect of drugs by MES and PTZ method.
13. Study of stereotype and anti-catatonic activity of drugs on rats/mice.
14. Study of anxiolytic activity of drugs using rats/mice.
15. Study of local anesthetics by different methods

Note: All laboratory techniques and animal experiments are demonstrated by simulated experiments by softwares and videos

Recommended Books (Latest Editions)

1. Rang H. P., Dale M. M., Ritter J. M., Flower R. J., Rang and Dale's Pharmacology,.Churchil Livingstone Elsevier
2. Katzung B. G., Masters S. B., Trevor A. J., Basic and clinical pharmacology, Tata Mc Graw-Hill
3. Goodman and Gilman's, The Pharmacological Basis of Therapeutics
4. Marry Anne K. K., Lloyd Yee Y., Brian K. A., Robbin L.C., Joseph G. B., Wayne A. K., Bradley R.W., Applied Therapeutics, The Clinical use of Drugs, The Point Lippincott Williams & Wilkins
5. Mycek M.J, Gelnet S.B and Perper M.M. Lippincott's Illustrated Reviews-Pharmacology

6. K.D.Tripathi. Essentials of Medical Pharmacology, JAYPEE Brothers Medical Publishers (P) Ltd, New Delhi.

7. Sharma H. L., Sharma K. K., Principles of Pharmacology, Paras medical publisher

8. Modern Pharmacology with clinical Applications, by Charles R.Craig& Robert,

9. Ghosh MN. Fundamentals of Experimental Pharmacology. Hilton & Company, Kolkata.

10. Kulkarni SK. Handbook of experimental pharmacology. VallabhPrakashan,

BP 405 T.PHARMACOGNOSY AND PHYTOCHEMISTRY I (Theory)

45 Hours

Scope: The subject involves the fundamentals of Pharmacognosy like scope, classification of crude drugs, their identification and evaluation, phytochemicals present in them and their medicinal properties.

Objectives: Upon completion of the course, the student shall be able

1. to know the techniques in the cultivation and production of crude drugs
2. to know the crude drugs, their uses and chemical nature
3. know the evaluation techniques for the herbal drugs
4. to carry out the microscopic and morphological evaluation of crude drugs

Course Content:

UNIT-I **10 Hours**

Introduction to Pharmacognosy:

(a) Definition, history, scope and development of Pharmacognosy

(b) Sources of Drugs – Plants, Animals, Marine & Tissue culture

(c) Organized drugs, unorganized drugs (dried latex, dried juices, dried extracts, gums and mucilages, oleoresins and oleo- gum -resins).

Classification of drugs:

Alphabetical, morphological, taxonomical, chemical, pharmacological, chemo and sero taxonomical classification of drugs

Quality control of Drugs of Natural Origin:

Adulteration of drugs of natural origin. Evaluation by organoleptic, microscopic, physical, chemical and biological methods and properties.

Quantitative microscopy of crude drugs including lycopodium spore method, leafconstants, camera lucida and diagrams of microscopic objects to scale with camera lucida.

UNIT-II **10 Hours**

Cultivation, Collection, Processing and storage of drugs of natural origin:

Cultivation and Collection of drugs of natural origin

Factors influencing cultivation of medicinal plants.

Plant hormones and their applications.

Polyploidy, mutation and hybridization with reference to medicinal plants

Conservation of medicinal plants

UNIT-III **07 Hours**

Plant tissue culture:

Historical development of plant tissue culture, types of cultures, Nutritional requirements, growth and their maintenance.

Applications of plant tissue culture in pharmacognosy.

Edible vaccines

UNIT IV **10 Hours**

Pharmacognosy in various systems of medicine:

Role of Pharmacognosy in allopathy and traditional systems of medicine namely, Ayurveda, Unani, Siddha, Homeopathy and Chinese systems of medicine.

Introduction to secondary metabolites:

Definition, classification, properties and test for identification of Alkaloids, Glycosides, Flavonoids, Tannins, Volatile oil and Resins

UNIT V **08 Hours**

Study of biological source, chemical nature and uses of drugs of natural origin containing following drugs

Plant Products:

Fibers - Cotton, Jute, Hemp

Hallucinogens, Teratogens, Natural allergens

Primary metabolites:

General introduction, detailed study with respect to chemistry, sources, preparation, evaluation, preservation, storage, therapeutic used and commercial utility as Pharmaceutical Aids and/or Medicines for the following Primary metabolites:

Carbohydrates: Acacia, Agar, Tragacanth, Honey

Proteins and Enzymes : Gelatin, casein, proteolytic enzymes (Papain, bromelain, serratiopeptidase, urokinase, streptokinase, pepsin).

Lipids(Waxes, fats, fixed oils) : Castor oil, Chaulmoogra oil, Wool Fat, Bees Wax

Marine Drugs:

Novel medicinal agents from marine sources

BP408 P. PHARMACOGNOSY AND PHYTOCHEMISTRY I (Practical)

4 Hours/Week

1. Analysis of crude drugs by chemical tests: **(**i)Tragaccanth (ii) Acacia (iii)Agar (iv) Gelatin (v) starch (vi) Honey (vii) Castor oil
2. Determination of stomatal number and index
3. Determination of vein islet number, vein islet termination and paliside ratio.
4. Determination of size of starch grains, calcium oxalate crystals by eye piece micrometer
5. Determination of Fiber length and width
6. Determination of number of starch grains by Lycopodium spore method
7. Determination of Ash value
8. Determination of Extractive values of crude drugs
9. Determination of moisture content of crude drugs
10. Determination of swelling index and foaming

Recommended Books: (Latest Editions)

1. W.C.Evans, Trease and Evans Pharmacognosy, 16th edition, W.B. Sounders & Co., London, 2009.
2. Tyler, V.E., Brady, L.R. and Robbers, J.E., Pharmacognosy, 9th Edn., Lea and Febiger, Philadelphia, 1988.
3. Text Book of Pharmacognosy by T.E. Wallis
4. Mohammad Ali. Pharmacognosy and Phytochemistry, CBS Publishers & Distribution, New Delhi.
5. Text book of Pharmacognosy by C.K. Kokate, Purohit, Gokhlae (2007), 37th Edition, Nirali Prakashan, New Delhi.
6. Herbal drug industry by R.D. Choudhary (1996), Ist Edn, Eastern Publisher, New Delhi.
7. Essentials of Pharmacognosy, Dr.SH.Ansari, IInd edition, Birla publications, New Delhi, 2007
8. Practical Pharmacognosy: C.K. Kokate, Purohit, Gokhlae
9. Anatomy of Crude Drugs by M.A. Iyengar

SEMESTER V

BP501T. MEDICINAL CHEMISTRY – II (Theory)

45 Hours

Scope: This subject is designed to impart fundamental knowledge on the structure, chemistry and therapeutic value of drugs. The subject emphasizes on structure activity relationships of drugs, importance of physicochemical properties and metabolism of drugs. The syllabus also emphasizes on chemical synthesis of important drugs under each class.

Objectives: Upon completion of the course the student shall be able to

1. Understand the chemistry of drugs with respect to their pharmacological activity
2. Understand the drug metabolic pathways, adverse effect and therapeutic value of drugs
3. Know the Structural Activity Relationship of different class of drugs
4. Study the chemical synthesis of selected drugs

Course Content:

Study of the development of the following classes of drugs, Classification, mechanism of action, uses of drugs mentioned in the course, Structure activity relationship of selective class of drugs as specified in the course and synthesis of drugs superscripted (*)

UNIT- I **10 Hours**

Antihistaminic agents: Histamine, receptors and their distribution in the humanbody

H_1–antagonists: Diphenhydramine hydrochloride*, Dimenhydrinate, Doxylamines cuccinate, Clemastine fumarate, Diphenylphyraline hydrochloride, Tripelenamine hydrochloride, Chlorcyclizine hydrochloride, Meclizine hydrochloride, Buclizine hydrochloride, Chlorpheniramine maleate, Triprolidine hydrochloride*, Phenidamine tartarate, Promethazine hydrochloride*, Trimeprazine tartrate, Cyproheptadine hydrochloride, Azatidine maleate, Astemizole, Loratadine, Cetirizine, Levocetrazine Cromolyn sodium

H_2-antagonists: Cimetidine*, Famotidine, Ranitidin.

Gastric Proton pump inhibitors: Omeprazole, Lansoprazole, Rabeprazole, Pantoprazole

Anti-neoplastic agents:

Alkylating agents: Meclorethamine*, Cyclophosphamide, Melphalan,

Chlorambucil, Busulfan, Thiotepa

Antimetabolites: Mercaptopurine*, Thioguanine, Fluorouracil, Floxuridine, Cytarabine, Methotrexate*, Azathioprine

Antibiotics: Dactinomycin, Daunorubicin, Doxorubicin, Bleomycin

Plant products: Etoposide, Vinblastin sulphate, Vincristin sulphate

Miscellaneous: Cisplatin, Mitotane.

UNIT – II **10 Hours**

Anti-anginal:

Vasodilators: Amyl nitrite, Nitroglycerin*, Pentaerythritol tetranitrate, Isosorbide dinitrite*, Dipyridamole.

Calcium channel blockers: Verapamil, Bepridil hydrochloride, Diltiazem hydrochloride, Nifedipine, Amlodipine, Felodipine, Nicardipine, Nimodipine.

Diuretics:

Carbonic anhydrase inhibitors: Acetazolamide*, Methazolamide, Dichlorphenamide.

Thiazides: Chlorthiazide*, Hydrochlorothiazide, Hydroflumethiazide, Cyclothiazide,

Loop diuretics: Furosemide*, Bumetanide, Ethacrynic acid.

Potassium sparing Diuretics: Spironolactone, Triamterene, Amiloride.

Osmotic Diuretics: Mannitol

Anti-hypertensive Agents: Timolol, Captopril, Lisinopril, Enalapril, Benazepril hydrochloride, Quinapril hydrochloride, Methyldopate hydrochloride,* Clonidine hydrochloride, Guanethidine monosulphate, Guanabenz acetate, Sodium nitroprusside, Diazoxide, Minoxidil, Reserpine, Hydralazine hydrochloride.

UNIT- III **10 Hours**

Anti-arrhythmic Drugs: Quinidine sulphate, Procainamide hydrochloride, Disopyramide phosphate*, Phenytoin sodium, Lidocaine hydrochloride, Tocainide hydrochloride, Mexiletine hydrochloride, Lorcainide hydrochloride, Amiodarone, Sotalol.

Anti-hyperlipidemic agents: Clofibrate, Lovastatin, Cholesteramine and Cholestipol

Coagulant & Anticoagulants: Menadione, Acetomenadione, Warfarin*, Anisindione, clopidogrel

Drugs used in Congestive Heart Failure: Digoxin, Digitoxin, Nesiritide, Bosentan, Tezosentan.

UNIT- IV **08 Hours**

Drugs acting on Endocrine system

Nomenclature, Stereochemistry and metabolism of steroids

Sex hormones: Testosterone, Nandralone, Progestrones, Oestriol, Oestradiol, Oestrione, Diethyl stilbestrol.
Drugs for erectile dysfunction: Sildenafil, Tadalafil.
Oral contraceptives: Mifepristone, Norgestril, Levonorgestrol
Corticosteroids: Cortisone, Hydrocortisone, Prednisolone, Betamethasone, Dexamethasone
Thyroid and antithyroid drugs: L-Thyroxine, L-Thyronine, Propylthiouracil, Methimazole.

UNIT – V **07 Hours**

Antidiabetic agents:

Insulin and its preparations

Sulfonyl ureas: Tolbutamide*, Chlorpropamide, Glipizide, Glimepiride.

Biguanides: Metformin.

Thiazolidinediones: Pioglitazone, Rosiglitazone.

Meglitinides: Repaglinide, Nateglinide.

Glucosidase inhibitors: Acrabose, Voglibose.

Local Anesthetics: SAR of Local anesthetics

Benzoic Acid derivatives; Cocaine, Hexylcaine, Meprylcaine, Cyclomethycaine, Piperocaine.

Amino Benzoic acid derivatives: Benzocaine*, Butamben, Procaine*, Butacaine, Propoxycaine, Tetracaine, Benoxinate.

Lidocaine/Anilide derivatives: Lignocaine, Mepivacaine, Prilocaine, Etidocaine.

Miscellaneous: Phenacaine, Diperodon, Dibucaine.*

Recommended Books (Latest Editions)

1. Wilson and Giswold's Organic medicinal and Pharmaceutical Chemistry.
2. Foye's Principles of Medicinal Chemistry.
3. Burger's Medicinal Chemistry, Vol I to IV.
4. Introduction to principles of drug design- Smith and Williams.
5. Remington's Pharmaceutical Sciences.
6. Martindale's extra pharmacopoeia.
7. Organic Chemistry by I.L. Finar, Vol. II.
8. The Organic Chemistry of Drug Synthesis by Lednicer, Vol. 1to 5.
9. Indian Pharmacopoeia.
10. Text book of practical organic chemistry- A.I.Vogel.

BP 502 T. Industrial PharmacyI (Theory)

45 Hours

Scope: Course enables the student to understand and appreciate the influence of pharmaceutical additives and various pharmaceutical dosage forms on the performance of the drug product.

Objectives: Upon completion of the course the student shall be able to

1. Know the various pharmaceutical dosage forms and their manufacturing techniques.
2. Know various considerations in development of pharmaceutical dosage forms
3. Formulate solid, liquid and semisolid dosage forms and evaluate them for their quality

Course content:

3 hours/ week

UNIT-I **07 Hours**

Preformulation Studies: Introduction to preformulation, goals and objectives, study of physicochemical characteristics of drug substances.

a. Physical properties: Physical form (crystal & amorphous), particle size, shape, flow properties, solubility profile (pKa, pH, partition coefficient), polymorphism

b. Chemical Properties: Hydrolysis, oxidation, reduction, racemisation, polymerization

BCS classification of drugs & its significant

Application of preformulation considerations in the development of solid, liquid oral and parenteral dosage forms and its impact on stability of dosage forms.

UNIT-II **10 Hours**

Tablets:

a. Introduction, ideal characteristics of tablets, classification of tablets. Excipients, Formulation of tablets, granulation methods, compression and processing problems. Equipments and tablet tooling.

b. Tablet coating: Types of coating, coating materials, formulation of coating composition, methods of coating, equipment employed and defects in coating.

c. Quality control tests: In process and finished product tests

Liquid orals: Formulation and manufacturing consideration of syrups and elixirs suspensions and emulsions; Filling and packaging; evaluation of liquid orals official in pharmacopoeia

UNIT-III **08 Hours**

Capsules:

a. ***Hard gelatin capsules:*** Introduction, Production of hard gelatin capsule shells. size of capsules, Filling, finishing and special techniques of formulation of hard gelatin capsules, manufacturing defects. In process and final product quality control tests for capsules.

b. ***Soft gelatin capsules:*** Nature of shell and capsule content, size of capsules,importance of base adsorption and minim/gram factors, production, in process and final product quality control tests. Packing, storage and stability testing of soft gelatin capsules and their applications.

Pellets: Introduction, formulation requirements, pelletization process, equipments for manufacture of pellets

UNIT-IV **10 Hours**

Parenteral Products:

a. Definition, types, advantages and limitations. Preformulation factors and essential requirements, vehicles, additives, importance of isotonicity

b. Production procedure, production facilities and controls,
aseptic processing

c. Formulation of injections, sterile powders, large volume parenterals and lyophilized products.

d. Containers and closures selection, filling and sealing of ampoules, vials and infusion fluids. Quality control tests of parenteral products.

Ophthalmic Preparations: Introduction, formulation considerations; formulation of eye drops, eye ointments and eye lotions; methods of preparation; labeling, containers; evaluation of ophthalmic preparations

UNIT-V **10 Hours**

Cosmetics: Formulation and preparation of the following cosmetic preparations: lipsticks, shampoos, cold cream and vanishing cream, tooth pastes, hair dyes and sunscreens.

Pharmaceutical Aerosols: Definition, propellants, containers, valves, types of aerosol systems; formulation and manufacture of aerosols; Evaluation of aerosols; Quality control and stability studies.

Packaging Materials Science: Materials used for packaging of pharmaceutical products, factors influencing choice of containers, legal and official requirements for containers, stability aspects of packaging materials, quality control tests.

BP 506 P. Industrial PharmacyI (Practical)

4 Hours/week

1. Preformulation studies on paracetamol/asparin/or any other drug
2. Preparation and evaluation of Paracetamol tablets
3. Preparation and evaluation of Aspirin tablets
4. Coating of tablets- film coating of tables/granules
5. Preparation and evaluation of Tetracycline capsules
6. Preparation of Calcium Gluconate injection
7. Preparation of Ascorbic Acid injection
8. Qulaity control test of (as per IP) marketed tablets and capsules
9. Preparation of Eye drops/ and Eye ointments
10. Preparation of Creams (cold / vanishing cream)
11. Evaluation of Glass containers (as per IP)

Recommended Books: (Latest Editions)

1. Pharmaceutical dosage forms - Tablets, volume 1 -3 by H.A. Liberman, Leon Lachman &J.B.Schwartz
2. Pharmaceutical dosage form - Parenteral medication vol- 1&2 by Liberman & Lachman
3. Pharmaceutical dosage form disperse system VOL-1 by Liberman & Lachman
4. Modern Pharmaceutics by Gilbert S. Banker & C.T. Rhodes, 3rd Edition
5. Remington: The Science and Practice of Pharmacy, 20th edition Pharmaceutical Science (RPS)
6. Theory and Practice of Industrial Pharmacy by Liberman & Lachman
7. Pharmaceutics- The science of dosage form design by M.E.Aulton, Churchill livingstone, Latest edition
8. Introduction to Pharmaceutical Dosage Forms by H. C.Ansel, Lea &Febiger, Philadelphia, 5thedition, 2005
9. Drug stability - Principles and practice by Cartensen & C.J. Rhodes, 3rd Edition, Marcel Dekker Series, Vol 107.

BP503.T. PHARMACOLOGY-II (Theory)

45 Hours

Scope: This subject is intended to impart the fundamental knowledge on various aspects (classification, mechanism of action, therapeutic effects, clinical uses, side effects and contraindications) of drugs acting on different systems of body and in addition,emphasis on the basic concepts of bioassay.

Objectives: Upon completion of this course the student should be able to

1. Understand the mechanism of drug action and its relevance in the treatment of different diseases
2. Demonstrate isolation of different organs/tissues from the laboratory animals by simulated experiments
3. Demonstrate the various receptor actions using isolated tissue preparation
4. Appreciate correlation of pharmacology with related medical sciences

Course Content:

UNIT-I **10hours**

1. Pharmacology of drugs acting on cardio vascular system

a. Introduction to hemodynamic and electrophysiology of heart.
b. Drugs used in congestive heart failure
c. Anti-hypertensive drugs.
d. Anti-anginal drugs.
e. Anti-arrhythmic drugs.
f. Anti-hyperlipidemic drugs.

UNIT-II **10hours**

1. Pharmacology of drugs acting on cardio vascular system

a. Drug used in the therapy of shock.
b. Hematinics, coagulants and anticoagulants.
c. Fibrinolytics and anti-platelet drugs
d. Plasma volume expanders

2. Pharmacology of drugs acting on urinary system

a. Diuretics
b. Anti-diuretics.

UNIT-III **10hours**

3. Autocoids and related drugs

a. Introduction to autacoids and classification
b. Histamine, 5-HT and their antagonists.
c. Prostaglandins, Thromboxanes and Leukotrienes.
d. Angiotensin, Bradykinin and Substance P.
e. Non-steroidal anti-inflammatory agents
f. Anti-gout drugs
g. Antirheumatic drugs

UNIT-IV **08hours**

5. Pharmacology of drugs acting on endocrine system

a. Basic concepts in endocrine pharmacology.
b. Anterior Pituitary hormones- analogues and their inhibitors.
c. Thyroid hormones- analogues and their inhibitors.
d. Hormones regulating plasma calcium level- Parathormone, Calcitonin and Vitamin-D.
d. Insulin, Oral Hypoglycemic agents and glucagon.
e. ACTH and corticosteroids.

UNIT-V **07hours**

5. Pharmacology of drugs acting on endocrine system

a. Androgens and Anabolic steroids.
b. Estrogens, progesterone and oral contraceptives.
c. Drugs acting on the uterus.

6. Bioassay

a. Principles and applications of bioassay.
b.Types of bioassay
c. Bioassay of insulin, oxytocin, vasopressin, ACTH,d-tubocurarine,digitalis, histamine and 5-HT

BP 507 P. PHARMACOLOGY-II (Practical)

4Hrs/Week

1. Introduction to *in-vitro* pharmacology and physiological salt solutions.
2. Effect of drugs on isolated frog heart.
3. Effect of drugs on blood pressure and heart rate of dog.
4. Study of diuretic activity of drugs using rats/mice.
5. DRC of acetylcholine using frog rectus abdominis muscle.
6. Effect of physostigmine and atropine on DRC of acetylcholine using frog rectus abdominis muscle and rat ileum respectively.
7. Bioassay of histamine using guinea pig ileum by matching method.
8. Bioassay of oxytocin using rat uterine horn by interpolation method.
9. Bioassay of serotonin using rat fundus strip by three point bioassay.
10. Bioassay of acetylcholine using rat ileum/colon by four point bioassay.
11. Determination of PA_2 value of prazosin using rat anococcygeus muscle (by Schilds plot method).
12. Determination of PD_2 value using guinea pig ileum.
13. Effect of spasmogens and spasmolytics using rabbit jejunum.
14. Anti-inflammatory activity of drugs using carrageenan induced paw-edema model.
15. Analgesic activity of drug using central and peripheral methods

Note: All laboratory techniques and animal experiments are demonstrated by simulated experiments by softwares and videos

Recommended Books (Latest Editions)

1. Rang H. P., Dale M. M., Ritter J. M., Flower R. J., Rang and Dale's Pharmacology, Churchil Livingstone Elsevier
2. Katzung B. G., Masters S. B., Trevor A. J., Basic and clinical pharmacology, Tata Mc Graw-Hill.
3. Goodman and Gilman's, The Pharmacological Basis of Therapeutics
4. Marry Anne K. K., Lloyd Yee Y., Brian K. A., Robbin L.C., Joseph G. B., Wayne A. K., Bradley R.W., Applied Therapeutics, The Clinical use of Drugs, The Point Lippincott Williams & Wilkins.
5. Mycek M.J, Gelnet S.B and Perper M.M. Lippincott's Illustrated Reviews-Pharmacology.
6. K.D.Tripathi. Essentials of Medical Pharmacology, , JAYPEE Brothers Medical Publishers (P) Ltd, New Delhi.
7. Sharma H. L., Sharma K. K., Principles of Pharmacology, Paras medical publisher
8. Modern Pharmacology with clinical Applications, by Charles R.Craig& Robert.
9. Ghosh MN. Fundamentals of Experimental Pharmacology. Hilton & Company, Kolkata.
10. Kulkarni SK. Handbook of experimental pharmacology. Vallabh Prakashan.

BP504 T. PHARMACOGNOSY AND PHYTOCHEMISTRY II (Theory)

45Hours

Scope: The main purpose of subject is to impart the students the knowledge of how the secondary metabolites are produced in the crude drugs, how to isolate and identify and produce them industrially. Also this subject involves the study of producing the plants and phytochemicals through plant tissue culture, drug interactions and basic principles of traditional system of medicine

Objectives: Upon completion of the course, the student shall be able

1. to know the modern extraction techniques, characterization and identification of the herbal drugs and phytoconstituents
2. to understand the preparation and development of herbal formulation.
3. to understand the herbal drug interactions
4. to carryout isolation and identification of phytoconstituents

Course Content:

UNIT-I **7 Hours**

Metabolic pathways in higher plants and their determination

a) Brief study of basic metabolic pathways and formation of different secondary metabolites through these pathways- Shikimic acid pathway, Acetate pathways and Amino acid pathway.
b) Study of utilization of radioactive isotopes in the investigation of Biogenetic studies.

UNIT-II **14 Hours**

General introduction, composition, chemistry & chemical classes, biosources, therapeutic uses and commercial applications of following

secondary metabolites:

Alkaloids: Vinca, Rauwolfia, Belladonna, Opium,
Phenylpropanoids and Flavonoids: Lignans, Tea, Ruta
Steroids, Cardiac Glycosides & Triterpenoids: Liquorice, Dioscorea, Digitalis
Volatile oils: Mentha, Clove, Cinnamon, Fennel, Coriander,
Tannins: Catechu, Pterocarpus
Resins: Benzoin, Guggul, Ginger, Asafoetida, Myrrh, Colophony
Glycosides: Senna, Aloes, Bitter Almond
Iridoids, Other terpenoids & Naphthaquinones: Gentian, Artemisia, taxus, carotenoids

UNIT-III **06 Hours**

Isolation, Identification and Analysis of Phytoconstituents

a) Terpenoids: Menthol, Citral, Artemisin
b) Glycosides: Glycyrhetinic acid & Rutin
c) Alkaloids: Atropine,Quinine,Reserpine,Caffeine
d) Resins: Podophyllotoxin, Curcumin

UNIT-IV **10 Hours**

Industrial production, estimation and utilization of the following phytoconstituents: Forskolin, Sennoside, Artemisinin, Diosgenin, Digoxin, Atropine, Podophyllotoxin, Caffeine, Taxol, Vincristine and Vinblastine

UNIT V **8 Hours**

Basics of Phytochemistry

Modern methods of extraction, application of latest techniques like Spectroscopy, chromatography and electrophoresis in the isolation, purification and identification of crude drugs.

BP 508 P. PHARMACOGNOSY AND PHYTOCHEMISTRY II (Practical)

4 Hours/Week

1. Morphology, histology and powder characteristics & extraction & detection of: Cinchona, Cinnamon, Senna, Clove, Ephedra, Fennel and Coriander
2. Exercise involving isolation & detection of active principles
   a. Caffeine - from tea dust.
   b. Diosgenin from Dioscorea
   c. Atropine from Belladonna
   d. Sennosides from Senna
3. Separation of sugars by Paper chromatography
4. TLC of herbal extract
5. Distillation of volatile oils and detection of phytoconstitutents by TLC
6. Analysis of crude drugs by chemical tests: **(**i) Asafoetida (ii) Benzoin (iii) Colophony (iv) Aloes (v) Myrrh

Recommended Books: (Latest Editions)

1. W.C.Evans, Trease and Evans Pharmacognosy, 16th edition, W.B. Sounders & Co., London, 2009.
2. Mohammad Ali. Pharmacognosy and Phytochemistry, CBS Publishers & Distribution, New Delhi.
3. Text book of Pharmacognosy by C.K. Kokate, Purohit, Gokhlae (2007), 37th Edition, Nirali Prakashan, New Delhi.
4. Herbal drug industry by R.D. Choudhary (1996), Ist Edn, Eastern Publisher, New Delhi.
5. Essentials of Pharmacognosy, Dr.SH.Ansari, IInd edition, Birla publications, New Delhi, 2007
6. Herbal Cosmetics by H.Pande, Asia Pacific Business press, Inc, New Delhi.
7. A.N. Kalia, Textbook of Industrial Pharmacognosy, CBS Publishers, New Delhi, 2005.
8. R Endress, Plant cell Biotechnology, Springer-Verlag, Berlin, 1994.
9. Pharmacognosy & Pharmacobiotechnology. James Bobbers, Marilyn KS, VE Tylor.
10. The formulation and preparation of cosmetic, fragrances and flavours.
11. Remington's Pharmaceutical sciences.
12. Text Book of Biotechnology by Vyas and Dixit.
13. Text Book of Biotechnology by R.C. Dubey.

BP 505 T. PHARMACEUTICAL JURISPRUDENCE (Theory)

45 Hours

Scope: This course is designed to impart basic knowledge on important legislations related to the profession of pharmacy in India.

Objectives: Upon completion of the course, the student shall be able to understand:

1. The Pharmaceutical legislations and their implications in the development and marketing of pharmaceuticals.
2. Various Indian pharmaceutical Acts and Laws
3. The regulatory authorities and agencies governing the manufacture and sale of pharmaceuticals
4. The code of ethics during the pharmaceutical practice

Course Content:

UNIT-I **10 Hours**

Drugs and Cosmetics Act, 1940 and its rules 1945:

Objectives, Definitions, Legal definitions of schedules to the Act and Rules

Import of drugs – Classes of drugs and cosmetics prohibited from import, Import under license or permit. Offences and penalties**.**

Manufacture of drugs – Prohibition of manufacture and sale of certain drugs,

Conditions for grant of license and conditions of license for manufacture of drugs, Manufacture of drugs for test, examination and analysis, manufacture of new drug, loan license and repacking license.

UNIT-II **10 Hours**

Drugs and Cosmetics Act, 1940 and its rules 1945.

Detailed study of Schedule G, H, M, N, P,T,U, V, X, Y, Part XII B, Sch F & DMR (OA)

Sale of Drugs – Wholesale, Retail sale and Restricted license. Offences and penalties

Labeling & Packing of drugs- General labeling requirements and specimen labels for drugs and cosmetics, List of permitted colors. Offences and penalties.

Administration of the Act and Rules – Drugs Technical Advisory Board, Central drugs Laboratory, Drugs Consultative Committee, Government drug analysts, Licensing authorities, controlling authorities, Drugs Inspectors

UNIT-III **10 Hours**

- **Pharmacy Act –1948**: Objectives, Definitions, Pharmacy Council of India; its constitution and functions, Education Regulations, State and Joint state pharmacy councils; constitution and functions, Registration of Pharmacists, Offences and

Penalties

- **Medicinal and Toilet Preparation Act –1955**: Objectives, Definitions, Licensing, Manufacture In bond and Outside bond, Export of alcoholic preparations, Manufacture of Ayurvedic, Homeopathic, Patent & Proprietary Preparations. Offences and Penalties.
- **Narcotic Drugs and Psychotropic substances Act-1985 and Rules**: Objectives, Definitions, Authorities and Officers, Constitution and Functions of narcotic & Psychotropic Consultative Committee, National Fund for Controlling the Drug Abuse, Prohibition, Control and Regulation, opium poppy cultivation and production of poppy straw, manufacture, sale and export of opium, Offences and Penalties

UNIT-IV **08 Hours**

- **Study of Salient Features of Drugs and Magic Remedies Act and its rules:** Objectives, Definitions, Prohibition of certain advertisements, Classes of Exempted advertisements, Offences and Penalties
- **Prevention of Cruelty to animals Act-1960:** Objectives, Definitions, Institutional Animal Ethics Committee, CPCSEA guidelines for Breeding and Stocking of Animals, Performance of Experiments, Transfer and acquisition of animals for experiment, Records, Power to suspend or revoke registration, Offences and Penalties
- **National Pharmaceutical Pricing Authority:** Drugs Price Control Order (DPCO)-2013. Objectives, Definitions, Sale prices of bulk drugs, Retail price of formulations, Retail price and ceiling price of scheduled formulations, National List of Essential Medicines (NLEM)

UNIT-V **07 Hours**

- **Pharmaceutical Legislations –** A brief review, Introduction, Study of drugs enquiry committee, Health survey and development committee, Hathi committee and Mudaliar committee
- **Code of Pharmaceutical ethics** D efinition, Pharmacist in relation to his job, trade, medical profession and his profession, Pharmacist's oath
- **Medical Termination of Pregnancy Act**
- **Right to Information Act**
- **Introduction to Intellectual Property Rights (IPR)**

Recommended books: (Latest Edition)

1. Forensic Pharmacy by B. Suresh

2. Text book of Forensic Pharmacy by B.M. Mithal
3. Hand book of drug law-by M.L. Mehra
4. A text book of Forensic Pharmacy by N.K. Jain
5. Drugs and Cosmetics Act/Rules by Govt. of India publications.
6. Medicinal and Toilet preparations act 1955 by Govt. of India publications.
7. Narcotic drugs and psychotropic substances act by Govt. of India publications
8. Drugs and Magic Remedies act by Govt. of India publication
9.Bare Acts of the said laws published by Government. Reference books (Theory)

SEMESTER VI

BP601T. MEDICINAL CHEMISTRY – III (Theory)

45 Hours

Scope: This subject is designed to impart fundamental knowledge on the structure, chemistry and therapeutic value of drugs. The subject emphasis on modern techniques of rational drug design like quantitative structure activity relationship (QSAR), Prodrug concept, combinatorial chemistry and Computer aided drug design (CADD). The subject also emphasizes on the chemistry, mechanism of action, metabolism, adverse effects, Structure Activity Relationships (SAR), therapeutic uses and synthesis of important drugs.

Objectives: Upon completion of the course student shall be able to

1. Understand the importance of drug design and different techniques of drug design.
2. Understand the chemistry of drugs with respect to their biological activity.
3. Know the metabolism, adverse effects and therapeutic value of drugs.
4. Know the importance of SAR of drugs.

Course Content:

Study of the development of the following classes of drugs, Classification, mechanism of action, uses of drugs mentioned in the course, Structure activity relationship of selective class of drugs as specified in the course and synthesis of drugs superscripted by (*)

UNIT – I **10 Hours**

Antibiotics

Historical background, Nomenclature, Stereochemistry, Structure activity relationship, Chemical degradation classification and important products of the following classes.

β-Lactam antibiotics: Penicillin, Cepholosporins, β- Lactamase inhibitors, Monobactams

Aminoglycosides: Streptomycin, Neomycin, Kanamycin

Tetracyclines: Tetracycline,Oxytetracycline, Chlortetracycline, Minocycline, Doxycycline

UNIT – II **10 Hours**

Antibiotics

Historical background, Nomenclature, Stereochemistry, Structure activity relationship, Chemical degradation classification and important products of the following classes.

Macrolide: Erythromycin Clarithromycin, Azithromycin.

Miscellaneous: Chloramphenicol*, Clindamycin.

Prodrugs: Basic concepts and application of prodrugs design.

Antimalarials: Etiology of malaria.

Quinolines: SAR, Quinine sulphate, Chloroquine*, Amodiaquine, Primaquine phosphate, Pamaquine*, Quinacrine hydrochloride, Mefloquine.

Biguanides and dihydro triazines: Cycloguanil pamoate, Proguanil.

Miscellaneous: Pyrimethamine, Artesunete, Artemether, Atovoquone.

UNIT – III **10 Hours**

Anti-tubercular Agents

Synthetic anti tubercular agents: Isoniozid*, Ethionamide, Ethambutol, Pyrazinamide, Para amino salicylic acid.*

Anti tubercular antibiotics: Rifampicin, Rifabutin, Cycloserine Streptomycine, Capreomycin sulphate.

Urinary tract anti-infective agents

Quinolones: SAR of quinolones, Nalidixic Acid,Norfloxacin, Enoxacin, Ciprofloxacin*, Ofloxacin, Lomefloxacin, Sparfloxacin, Gatifloxacin, Moxifloxacin

Miscellaneous: Furazolidine, Nitrofurantoin*, Methanamine.

Antiviral agents:

Amantadine hydrochloride, Rimantadine hydrochloride, Idoxuridine trifluoride, Acyclovir*, Gancyclovir, Zidovudine, Didanosine, Zalcitabine, Lamivudine, Loviride, Delavirding, Ribavirin, Saquinavir, Indinavir, Ritonavir.

UNIT – IV **08 Hours**

Antifungal agents:

Antifungal antibiotics: Amphotericin-B, Nystatin, Natamycin, Griseofulvin.

Synthetic Antifungal agents: Clotrimazole, Econazole, Butoconazole, Oxiconazole Tioconozole, Miconazole*, Ketoconazole, Terconazole, Itraconazole, Fluconazole, Naftifine hydrochloride, Tolnaftate*.

Anti-protozoal Agents: Metronidazole*, Tinidazole, Ornidazole, Diloxanide, Iodoquinol, Pentamidine Isethionate, Atovaquone, Eflornithine.

Anthelmintics: Diethylcarbamazine citrate*, Thiabendazole, Mebendazole*, Albendazole, Niclosamide, Oxamniquine, Praziquantal, Ivermectin.

Sulphonamides and Sulfones

Historical development, chemistry, classification and SAR of Sulfonamides: Sulphamethizole, Sulfisoxazole, Sulphamethizine, Sulfacetamide*, Sulphapyridine, Sulfamethoxaole*, Sulphadiazine, Mefenide acetate, Sulfasalazine.

Folate reductase inhibitors: Trimethoprim*, Cotrimoxazole.

Sulfones: Dapsone*.

UNIT – V **07 Hours**

Introduction to Drug Design

Various approaches used in drug design.

Physicochemical parameters used in quantitative structure activity relationship (QSAR) such as partition coefficient, Hammet's electronic parameter, Tafts steric parameter and Hansch analysis.

Pharmacophore modeling and docking techniques.

Combinatorial Chemistry: Concept and applications of combinatorial chemistry: solid phase and solution phase synthesis.

BP607P. MEDICINAL CHEMISTRY- III (Practical)

4 Hours / week

I Preparation of drugs and intermediates

1 Sulphanilamide

2 7-Hydroxy, 4-methyl coumarin

3 Chlorobutanol

4 Triphenyl imidazole

5 Tolbutamide

6 Hexamine

II Assay of drugs

1 Isonicotinic acid hydrazide

2 Chloroquine

3 Metronidazole

4 Dapsone

5 Chlorpheniramine maleate

6 Benzyl penicillin

III Preparation of medicinally important compounds or intermediates by Microwave irradiation technique

IV Drawing structures and reactions using chem draw®

V Determination of physicochemical properties such as logP, clogP, MR, Molecular weight, Hydrogen bond donors and acceptors for class of drugs course content using drug design software Drug likeliness screening (Lipinskies RO5)

Recommended Books (Latest Editions)

1. Wilson and Giswold's Organic medicinal and Pharmaceutical Chemistry.
2. Foye's Principles of Medicinal Chemistry.
3. Burger's Medicinal Chemistry, Vol I to IV.
4. Introduction to principles of drug design- Smith and Williams.
5. Remington's Pharmaceutical Sciences.
6. Martindale's extra pharmacopoeia.

7. Organic Chemistry by I.L. Finar, Vol. II.
8. The Organic Chemistry of Drug Synthesis by Lednicer, Vol. 1-5.
9. Indian Pharmacopoeia.
10. Text book of practical organic chemistry- A.I.Vogel.

BP602 T. PHARMACOLOGY-III (Theory)

45 Hours

Scope: This subject is intended to impart the fundamental knowledge on various aspects (classification, mechanism of action, therapeutic effects, clinical uses, side effects and contraindications) of drugs acting on respiratory and gastrointestinal system, infectious diseases, immuno-pharmacology and in addition,emphasis on the principles of toxicology and chronopharmacology.

Objectives: Upon completion of this course the student should be able to:

1. understand the mechanism of drug action and its relevance in the treatment of different infectious diseases
2. comprehend the principles of toxicology and treatment of various poisoningsand
3. appreciate correlation of pharmacology with related medical sciences.

Course Content:

UNIT-I **10hours**

1. Pharmacology of drugs acting on Respiratory system

a. Anti -asthmatic drugs
b. Drugs used in the management of COPD
c. Expectorants and antitussives
d. Nasal decongestants
e. Respiratory stimulants

2. Pharmacology of drugs acting on the Gastrointestinal Tract

a. Antiulcer agents.
b. Drugs for constipation and diarrhoea.
c. Appetite stimulants and suppressants.
d. Digestants and carminatives.
e. Emetics and anti-emetics.

UNIT-II **10hours**

3. Chemotherapy

a. General principles of chemotherapy.

b. Sulfonamides and cotrimoxazole.

c. Antibiotics- Penicillins, cephalosporins, chloramphenicol, macrolides, quinolones and fluoroquinolins, tetracycline and aminoglycosides

UNIT-III **10hours**

3. Chemotherapy

a. Antitubercular agents

b. Antileprotic agents

c. Antifungal agents

d. Antiviral drugs

e.Anthelmintics

f. Antimalarial drugs

g. Antiamoebic agents

UNIT-IV **08hours**

3. Chemotherapy

l. Urinary tract infections and sexually transmitted diseases.

m. Chemotherapy of malignancy.

4. Immunopharmacology

a. Immunostimulants

b. Immunosuppressant

Protein drugs, monoclonal antibodies, target drugs to antigen, biosimilars

UNIT-V **07hours**

5. Principles of toxicology

a. Definition and basic knowledge of acute, subacute and chronic toxicity.

b. Definition and basic knowledge of genotoxicity, carcinogenicity, teratogenicity and mutagenicity

c. General principles of treatment of poisoning

d. Clinical symptoms and management of barbiturates, morphine, organophosphosphorus compound and lead, mercury and arsenic poisoning.

6. Chronopharmacology

a. Definition of rhythm and cycles.

b. Biological clock and their significance leading to chronotherapy.

BP 608 P. PHARMACOLOGY-III (Practical)

4Hrs/Week

1. Dose calculation in pharmacological experiments
2. Antiallergic activity by mast cell stabilization assay
3. Study of anti-ulcer activity of a drug using pylorus ligand (SHAY) rat model and NSAIDS induced ulcer model.
4. Study of effect of drugs on gastrointestinal motility
5. Effect of agonist and antagonists on guinea pig ileum
6. Estimation of serum biochemical parameters by using semi- autoanalyser
7. Effect of saline purgative on frog intestine
8. Insulin hypoglycemic effect in rabbit
9. Test for pyrogens (rabbit method)
10. Determination of acute oral toxicity (LD50) of a drug from a given data
11. Determination of acute skin irritation / corrosion of a test substance
12. Determination of acute eye irritation / corrosion of a test substance
13. Calculation of pharmacokinetic parameters from a given data
14. Biostatistics methods in experimental pharmacology(student's t test, ANOVA)
15. Biostatistics methods in experimental pharmacology (Chi square test, Wilcoxon Signed Rank test)

**Experiments are demonstrated by simulated experiments/videos*

Recommended Books (Latest Editions)

1. Rang H. P., Dale M. M., Ritter J. M., Flower R. J., Rang and Dale's Pharmacology, Churchil Livingstone Elsevier
2. Katzung B. G., Masters S. B., Trevor A. J., Basic and clinical pharmacology, Tata Mc Graw-Hill
3. Goodman and Gilman's, The Pharmacological Basis of Therapeutics
4. Marry Anne K. K., Lloyd Yee Y., Brian K. A., Robbin L.C., Joseph G. B., Wayne A. K., Bradley R.W., Applied Therapeutics, The Clinical use of Drugs. The Point Lippincott Williams & Wilkins
5. Mycek M.J, Gelnet S.B and Perper M.M. Lippincott's Illustrated Reviews-Pharmacology
6. K.D.Tripathi. Essentials of Medical Pharmacology, , JAYPEE Brothers Medical Publishers (P) Ltd, New Delhi.
7. Sharma H. L., Sharma K. K., Principles of Pharmacology, Paras medical publisher Modern Pharmacology with clinical Applications, by Charles R.Craig& Robert,
8. Ghosh MN. Fundamentals of Experimental Pharmacology. Hilton & Company, Kolkata,
9. Kulkarni SK. Handbook of experimental pharmacology. VallabhPrakashan,
10. N.Udupa and P.D. Gupta, Concepts in Chronopharmacology.

BP 603 T. HERBAL DRUG TECHNOLOGY (Theory)

45 hours

Scope: This subject gives the student the knowledge of basic understanding of herbal drug industry, the quality of raw material, guidelines for quality of herbal drugs, herbal cosmetics, natural sweeteners, nutraceutical etc. The subject also emphasizes on Good Manufacturing Practices (GMP), patenting and regulatory issues of herbal drugs

Objectives: Upon completion of this course the student should be able to:

1. understand raw material as source of herbal drugs from cultivation to herbal drug product
2. know the WHO and ICH guidelines for evaluation of herbal drugs
3. know the herbal cosmetics, natural sweeteners, nutraceuticals
4. appreciate patenting of herbal drugs, GMP .

Course content:

UNIT-I **11 Hours**

Herbs as raw materials

Definition of herb, herbal medicine, herbal medicinal product, herbal drug preparation
Source of Herbs
Selection, identification and authentication of herbal materials
Processing of herbal raw material

Biodynamic Agriculture

Good agricultural practices in cultivation of medicinal plants including Organic farming.
Pest and Pest management in medicinal plants: Biopesticides/Bioinsecticides.

Indian Systems of Medicine

a) Basic principles involved in Ayurveda, Siddha, Unani and Homeopathy
b) Preparation and standardization of Ayurvedic formulations viz Aristas and Asawas, Ghutika,Churna, Lehya and Bhasma.

UNIT-II **7 Hours**

Nutraceuticals

General aspects, Market, growth, scope and types of products available in the market. Health benefits and role of Nutraceuticals in ailments like Diabetes, CVS diseases, Cancer, Irritable bowel syndrome and various Gastro intestinal diseases.
Study of following herbs as health food: Alfaalfa, Chicory, Ginger, Fenugreek, Garlic, Honey, Amla, Ginseng, Ashwagandha, Spirulina

Herbal-Drug and Herb-Food Interactions: General introduction to interaction and classification. Study of following drugs and their possible side effects and interactions: Hypercium, kava-kava, Ginkobiloba, Ginseng, Garlic, Pepper & Ephedra.

UNIT-III **10 Hours**

Herbal Cosmetics

Sources and description of raw materials of herbal origin used via, fixed oils, waxes, gums colours, perfumes, protective agents, bleaching agents, antioxidants in products such as skin care, hair care and oral hygiene products.

Herbal excipients:
Herbal Excipients – Significance of substances of natural origin as excipients – colorants, sweeteners, binders, diluents, viscosity builders, disintegrants, flavors & perfumes.

Herbal formulations :
Conventional herbal formulations like syrups, mixtures and tablets and Novel dosage forms like phytosomes

UNIT- IV **10 Hours**

Evaluation of Drugs WHO & ICH guidelines for the assessment of herbal drugs
Stability testing of herbal drugs.

Patenting and Regulatory requirements of natural products:
a) Definition of the terms: Patent, IPR, Farmers right, Breeder's right, Bioprospecting and Biopiracy
b) Patenting aspects of Traditional Knowledge and Natural Products. Case study of Curcuma & Neem.

Regulatory Issues - Regulations in India (ASU DTAB, ASU DCC), Regulation of manufacture of ASU drugs - Schedule Z of Drugs & Cosmetics Act for ASU drugs.

UNIT-V **07 Hours**

General Introduction to Herbal Industry
Herbal drugs industry: Present scope and future prospects.
A brief account of plant based industries and institutions involved in work on medicinal and aromatic plants in India.

Schedule T – Good Manufacturing Practice of Indian systems of medicine
Components of GMP (Schedule – T) and its objectives
Infrastructural requirements, working space, storage area, machinery and equipments, standard operating procedures, health and hygiene, documentation and records.

BP 609 P. HERBAL DRUG TECHNOLOGY (Practical)

4 hours/ week

1. To perform preliminary phytochemical screening of crude drugs.
2. Determination of the alcohol content of Asava and Arista
3. Evaluation of excipients of natural origin
4. Incorporation of prepared and standardized extract in cosmetic formulations like creams, lotions and shampoos and their evaluation.
5. Incorporation of prepared and standardized extract in formulations like syrups, mixtures and tablets and their evaluation as per Pharmacopoeial requirements.
6. Monograph analysis of herbal drugs from recent Pharmacopoeias
7. Determination of Aldehyde content
8. Determination of Phenol content
9. Determination of total alkaloids

Recommended Books: (Latest Editions)

1. Textbook of Pharmacognosy by Trease & Evans.
2. Textbook of Pharmacognosy by Tyler, Brady & Robber.
3. Pharmacognosy by Kokate, Purohit and Gokhale
4. Essential of Pharmacognosy by Dr.S.H.Ansari
5. Pharmacognosy & Phytochemistry by V.D.Rangari
6. Pharmacopoeal standards for Ayurvedic Formulation (Council of Research in Indian Medicine & Homeopathy)
7. Mukherjee, P.W. Quality Control of Herbal Drugs: An Approach to Evaluation of Botanicals. Business Horizons Publishers, New Delhi, India, 2002.

BP 604 T. BIOPHARMACEUTICS AND PHARMACOKINETICS (Theory)

45 Hours

Scope: This subject is designed to impart knowledge and skills of Biopharmaceutics and pharmacokinetics and their applications in pharmaceutical development, design of dose and dosage regimen and in solving the problems arised therein.

Objectives: Upon completion of the course student shall be able to:

1. Understand the basic concepts in biopharmaceutics and pharmacokinetics and their significance.
2. Use of plasma drug concentration-time data to calculate the pharmacokinetic parameters to describe the kinetics of drug absorption, distribution, metabolism, excretion, elimination.
3. To understand the concepts of bioavailability and bioequivalence of drug products and their significance.
4. Understand various pharmacokinetic parameters, their significance & applications.

Course Content:

UNIT-I **10 Hours**

Introduction to Biopharmaceutics

Absorption; Mechanisms of drug absorption through GIT, factors influencing drug absorption though GIT, absorption of drug from Non per oral extra-vascular routes, **Distribution** Tissue permeability of drugs, binding of drugs, apparent, volume of drug distribution, plasma and tissue protein binding of drugs, factors affecting protein-drug binding. Kinetics of protein binding, Clinical significance of protein binding of drugs

UNIT- II **10 Hours**

Elimination: Drug metabolism and basic understanding metabolic pathways renal excretion of drugs, factors affecting renal excretion of drugs, renal clearance, Non renal routes of drug excretion of drugs

Bioavailability and Bioequivalence: Definition and Objectives of bioavailability, absolute and relative bioavailability, measurement of bioavailability, *in-vitro* drug dissolution models, *in-vitro-in-vivo* correlations, bioequivalence studies, methods to enhance the dissolution rates and bioavailability of poorly soluble drugs.

UNIT- III **10 Hours**

Pharmacokinetics: Definition and introduction to Pharmacokinetics, Compartment models, Non compartment models, physiological models, One compartment open model. (a). Intravenous Injection (Bolus) (b). Intravenous infusion and (c) Extra vascular administrations. Pharmacokinetics parameters - K_E ,t1/2,Vd,AUC,Ka, Clt and CL_R- definitions methods of eliminations, understanding of their significance and application

UNIT- IV **08 Hours**

Multicompartment models: Two compartment open model. IV bolus
Kinetics of multiple dosing, steady state drug levels, calculation of loading and mainetnance doses and their significance in clinical settins.

UNIT- V **07 Hours**

Nonlinear Pharmacokinetics: a. Introduction, b. Factors causing Non-linearity.
c. Michaelis-menton method of estimating parameters, Explanation with example of drugs.

Recommended Books: (Latest Editions)

1. Biopharmaceutics and Clinical Pharmacokinetics by, Milo Gibaldi.
2. Biopharmaceutics and Pharmacokinetics; By Robert F Notari
3. Applied biopharmaceutics and pharmacokinetics, Leon Shargel and Andrew B.C.YU 4th edition,Prentice-Hall Inernational edition.USA
4. Bio pharmaceutics and Pharmacokinetics-A Treatise, By D. M. Brahmankar and Sunil B.Jaiswal,Vallabh Prakashan Pitampura, Delhi
5. Pharmacokinetics: By Milo Glbaldi Donald, R. Mercel Dekker Inc.
6. Hand Book of Clinical Pharmacokinetics, By Milo Gibaldi and Laurie Prescott by ADIS Health Science Press.
7. Biopharmaceutics; By Swarbrick
8. Clinical Pharmacokinetics, Concepts and Applications: By Malcolm Rowland and
9. Thomas, N. Tozen, Lea and Febrger, Philadelphia, 1995.
10. Dissolution, Bioavailability and Bioequivalence, By Abdou H.M, Mack, Publishing Company,Pennsylvania 1989.
11. Biopharmaceutics and Clinical Pharmacokinetics-An introduction 4th edition Revised and expanded by Rebort F Notari Marcel Dekker Inn, New York and Basel, 1987.
12. Remington's Pharmaceutical Sciences, By Mack Publishing Company, Pennsylvnia

BP 605 T. PHARMACEUTICAL BIOTECHNOLOGY (Theory)

45 Hours

Scope:

- Biotechnology has a long promise to revolutionize the biological sciences and technology.
- Scientific application of biotechnology in the field of genetic engineering, medicine and fermentation technology makes the subject interesting.
- Biotechnology is leading to new biological revolutions in diagnosis, prevention and cure of diseases, new and cheaper pharmaceutical drugs.
- Biotechnology has already produced transgenic crops and animals and the future promises lot more.
- It is basically a research-based subject.

Objectives: Upon completion of the subject student shall be able to;

1. Understanding the importance of Immobilized enzymes in Pharmaceutical Industries
2. Genetic engineering applications in relation to production of pharmaceuticals
3. Importance of Monoclonal antibodies in Industries
4. Appreciate the use of microorganisms in fermentation technology

Unit I **10 Hours**

a) Brief introduction to Biotechnology with reference to Pharmaceutical Sciences.

b) Enzyme Biotechnology- Methods of enzyme immobilization and applications.

c) Biosensors- Working and applications of biosensors in Pharmaceutical Industries.

d) Brief introduction to Protein Engineering.

e) Use of microbes in industry. Production of Enzymes- General consideration - Amylase, Catalase, Peroxidase, Lipase, Protease, Penicillinase.

f) Basic principles of genetic engineering.

Unit II **10 Hours**

a) Study of cloning vectors, restriction endonucleases and DNA ligase.

b) Recombinant DNA technology. Application of genetic engineering in medicine.

c) Application of r DNA technology and genetic engineering in the production of:

i) Interferon ii) Vaccines- hepatitis- B iii) Hormones-Insulin.

d) Brief introduction to PCR

Unit III **10 Hours**

Types of immunity- humoral immunity, cellular immunity

a) Structure of Immunoglobulins

b) Structure and Function of MHC

c) Hypersensitivity reactions, Immune stimulation and Immune suppressions.

d) General method of the preparation of bacterial vaccines, toxoids, viral vaccine, antitoxins, serum-immune blood derivatives and other products relative to immunity.

e) Storage conditions and stability of official vaccines

f) Hybridoma technology- Production, Purification and Applications

g) Blood products and Plasma Substituties.

Unit IV **08Hours**

a) Immuno blotting techniques- ELISA, Western blotting, Southern blotting.

b) Genetic organization of Eukaryotes and Prokaryotes

c) Microbial genetics including transformation, transduction, conjugation, plasmids and transposons.

d) Introduction to Microbial biotransformation and applications.

e) Mutation: Types of mutation/mutants.

Unit V **07 Hours**

a) Fermentation methods and general requirements, study of media, equipments, sterilization methods, aeration process, stirring.

b) Large scale production fermenter design and its various controls.

c) Study of the production of - penicillins, citric acid, Vitamin B12, Glutamic acid, Griseofulvin,

d) Blood Products: Collection, Processing and Storage of whole human blood, dried human plasma, plasma Substituties.

Recommended Books (Latest edition):

1. B.R. Glick and J.J. Pasternak: Molecular Biotechnology: Principles and Applications of RecombinantDNA: ASM Press Washington D.C.
2. RA Goldshy et. al., : Kuby Immunology.
3. J.W. Goding: Monoclonal Antibodies.
4. J.M. Walker and E.B. Gingold: Molecular Biology and Biotechnology by Royal

Society of Chemistry.
5. Zaborsky: Immobilized Enzymes, CRC Press, Degraland, Ohio.
6. S.B. Primrose: Molecular Biotechnology (Second Edition) Blackwell Scientific Publication.
7. Stanbury F., P., Whitakar A., and Hall J., S., Principles of fermentation technology, 2nd edition, Aditya books Ltd., New Delhi

BP606TPHARMACEUTICAL QUALITY ASSURANCE (Theory)

45 Hours

Scope: This course deals with the various aspects of quality control and quality assurance aspects of pharmaceutical industries. It deals with the important aspects like cGMP, QC tests, documentation, quality certifications and regulatory affairs.

Objectives: Upon completion of the course student shall be able to:

- understand the cGMP aspects in a pharmaceutical industry
- appreciate the importance of documentation
- understand the scope of quality certifications applicable to pharmaceutical industries
- understand the responsibilities of QA & QC departments

Course content:

UNIT – I **10 Hours**

Quality Assurance and Quality Management concepts: Definition and concept of Quality control, Quality assurance and GMP

Total Quality Management (TQM): Definition, elements, philosophies

ICH Guidelines: purpose, participants, process of harmonization, Brief overview of QSEM, with special emphasis on Q-series guidelines, ICH stability testing guidelines

Quality by design (QbD): Definition, overview, elements of QbD program, tools

ISO 9000 & ISO14000: Overview, Benefits, Elements, steps for registration

NABL accreditation : Principles and procedures

UNIT - II **10 Hours**

Organization and personnel: Personnel responsibilities, training, hygiene and personal records.

Premises: Design, construction and plant layout, maintenance, sanitation, environmental control, utilities and maintenance of sterile areas, control of contamination.

Equipments and raw materials: Equipment selection, purchase specifications, maintenance, purchase specifications and maintenance of stores for raw materials.

UNIT – III **10 Hours**

Quality Control: Quality control test for containers, rubber closures and secondary packing

materials.

Good Laboratory Practices: General Provisions, Organization and Personnel, Facilities, Equipment, Testing Facilities Operation, Test and Control Articles, Protocol for Conduct of a Nonclinical Laboratory Study, Records and Reports, Disqualification of Testing Facilities

UNIT – IV **08 Hours**

Complaints: Complaints and evaluation of complaints, Handling of return good, recalling and waste disposal.

Document maintenance in pharmaceutical industry: Batch Formula Record, Master Formula Record, SOP, Quality audit, Quality Review and Quality documentation, Reports and documents, distribution records.

UNIT – V **07 Hours**

Calibration and Validation: Introduction, definition and general principles of calibration, qualification and validation, importance and scope of validation, types of validation, validation master plan. Calibration of pH meter, Qualification of UV-Visible spectrophotometer, General principles of Analytical method Validation.

Warehousing: Good warehousing practice, materials management

Recommended Books: (Latest Edition)

1. Quality Assurance Guide by organization of Pharmaceutical Products of India.
2. Good Laboratory Practice Regulations, 2nd Edition, Sandy Weinberg Vol. 69.
3. Quality Assurance of Pharmaceuticals- A compendium of Guide lines and Related materials Vol I WHO Publications.
4. A guide to Total Quality Management- Kushik Maitra and Sedhan K Ghosh
5. How to Practice GMP's – P P Sharma.
6. ISO 9000 and Total Quality Management – Sadhank G Ghosh
7. The International Pharmacopoeia – Vol I, II, III, IV- General Methods of Analysis and Quality specification for Pharmaceutical Substances, Excipients and Dosage forms
8. Good laboratory Practices – Marcel Deckker Series
9. ICH guidelines, ISO 9000 and 14000 guidelines

SEMESTER VII

BP701T. INSTRUMENTAL METHODS OF ANALYSIS (Theory)

45 Hours

Scope: This subject deals with the application of instrumental methods in qualitative and quantitative analysis of drugs. This subject is designed to impart a fundamental knowledge on the principles and instrumentation of spectroscopic and chromatographic technique. This also emphasizes on theoretical and practical knowledge on modern analytical instruments that are used for drug testing.

Objectives: Upon completion of the course the student shall be able to

1. Understand the interaction of matter with electromagnetic radiations and its applications in drug analysis
2. Understand the chromatographic separation and analysis of drugs.
3. Perform quantitative & qualitative analysis of drugs using various analytical instruments.

Course Content:

UNIT –I **10 Hours**

UV Visible spectroscopy

Electronic transitions, chromophores, auxochromes, spectral shifts, solvent effect on absorption spectra, Beer and Lambert's law, Derivation and deviations.

Instrumentation - Sources of radiation, wavelength selectors, sample cells, detectors- Photo tube, Photomultiplier tube, Photo voltaic cell, Silicon Photodiode.

Applications - Spectrophotometric titrations, Single component and multi component analysis

Fluorimetry

Theory, Concepts of singlet, doublet and triplet electronic states, internal and external conversions, factors affecting fluorescence, quenching, instrumentation and applications

UNIT –II **10 Hours**

IR spectroscopy

Introduction, fundamental modes of vibrations in poly atomic molecules, sample handling, factors affecting vibrations

Instrumentation - Sources of radiation, wavelength selectors, detectors - Golay cell, Bolometer, Thermocouple, Thermister, Pyroelectric detector and applications

Flame Photometry-Principle, interferences, instrumentation and applications

Atomic absorption spectroscopy- Principle, interferences, instrumentation and applications

Nepheloturbidometry- Principle, instrumentation and applications

UNIT –III **10 Hours**

Introduction to chromatography

Adsorption and partition column chromatography-Methodology, advantages, disadvantages and applications.

Thin layer chromatography- Introduction, Principle, Methodology, Rf values, advantages, disadvantages and applications.

Paper chromatography-Introduction, methodology, development techniques, advantages, disadvantages and applications

Electrophoresis– Introduction, factors affecting electrophoretic mobility, Techniques of paper, gel, capillary electrophoresis, applications

UNIT –IV **08 Hours**

Gas chromatography - Introduction, theory, instrumentation, derivatization, temperature programming, advantages, disadvantages and applications

High performance liquid chromatography (HPLC)-Introduction, theory, instrumentation, advantages and applications.

UNIT –V **07 Hours**

Ion exchange chromatography- Introduction, classification, ion exchange resins, properties, mechanism of ion exchange process, factors affecting ion exchange, methodology and applications

Gel chromatography- Introduction, theory, instrumentation and applications

Affinity chromatography- Introduction, theory, instrumentation and applications

BP705P. INSTRUMENTAL METHODS OF ANALYSIS (Practical)

4 Hours/Week

1. Determination of absorption maxima and effect of solvents on absorption maxima of organic compounds
2. Estimation of dextrose by colorimetry
3. Estimation of sulfanilamide by colorimetry
4. Simultaneous estimation of ibuprofen and paracetamol by UV spectroscopy
5. Assay of paracetamol by UV- Spectrophotometry
6. Estimation of quinine sulfate by fluorimetry
7. Study of quenching of fluorescence
8. Determination of sodium by flame photometry
9. Determination of potassium by flame photometry
10. Determination of chlorides and sulphates by nephelo turbidometry
11. Separation of amino acids by paper chromatography
12. Separation of sugars by thin layer chromatography
13. Separation of plant pigments by column chromatography
14. Demonstration experiment on HPLC
15. Demonstration experiment on Gas Chromatography

Recommended Books (Latest Editions)

1. Instrumental Methods of Chemical Analysis by B.K Sharma
2. Organic spectroscopy by Y.R Sharma
3. Text book of Pharmaceutical Analysis by Kenneth A. Connors
4. Vogel's Text book of Quantitative Chemical Analysis by A.I. Vogel
5. Practical Pharmaceutical Chemistry by A.H. Beckett and J.B. Stenlake
6. Organic Chemistry by I. L. Finar
7. Organic spectroscopy by William Kemp
8. Quantitative Analysis of Drugs by D. C. Garrett
9. Quantitative Analysis of Drugs in Pharmaceutical Formulations by P. D. Sethi
10. Spectrophotometric identification of Organic Compounds by Silverstein

BP 702 T. INDUSTRIAL PHARMACYII (Theory)

45 Hours

Scope: This course is designed to impart fundamental knowledge on pharmaceutical product development and translation from laboratory to market

Objectives: Upon completion of the course, the student shall be able to:

1. Know the process of pilot plant and scale up of pharmaceutical dosage forms
2. Understand the process of technology transfer from lab scale to commercial batch
3. Know different Laws and Acts that regulate pharmaceutical industry
4. Understand the approval process and regulatory requirements for drug products

Course Content:

UNIT-I **10 Hours**

Pilot plant scale up techniques: General considerations - including significance of personnel requirements, space requirements, raw materials, Pilot plant scale up considerations for solids, liquid orals, semi solids and relevant documentation, SUPAC guidelines, Introduction to platform technology

UNIT-II **10 Hours**

Technology development and transfer: WHO guidelines for Technology Transfer(TT): Terminology, Technology transfer protocol, Quality risk management, Transfer from R & D to production (Process, packaging and cleaning), Granularity of TT Process (API, excipients, finished products, packaging materials) Documentation, Premises and equipments, qualification and validation, quality control, analytical method transfer, Approved regulatory bodies and agencies, Commercialization - practical aspects and problems (case studies), TT agencies in India - APCTD, NRDC, TIFAC, BCIL, TBSE / SIDBI; TT related documentation - confidentiality agreement, licensing, MoUs, legal issues

UNIT-III **10 Hours**

Regulatory affairs: Introduction, Historical overview of Regulatory Affairs, Regulatory authorities, Role of Regulatory affairs department, Responsibility of Regulatory Affairs Professionals

Regulatory requirements for drug approval: Drug Development Teams, Non-Clinical Drug Development, Pharmacology, Drug Metabolism and Toxicology, General considerations of Investigational New Drug (IND) Application, Investigator's Brochure (IB) and New Drug Application (NDA), Clinical research / BE studies, Clinical Research Protocols, Biostatistics in Pharmaceutical Product Development, Data Presentation for FDA Submissions, Management of Clinical Studies.

UNIT-IV **08 Hours**

Quality management systems: Quality management & Certifications: Concept of Quality, Total Quality Management, Quality by Design (QbD), Six Sigma concept, Out of Specifications (OOS), Change control, Introduction to ISO 9000 series of quality systems standards, ISO 14000, NABL, GLP

UNIT-V **07 Hours**

Indian Regulatory Requirements: Central Drug Standard Control Organization (CDSCO) and State Licensing Authority: Organization, Responsibilities, Certificate of Pharmaceutical Product (COPP), Regulatory requirements and approval procedures for New Drugs.

Recommended Books: (Latest Editions)

1. Regulatory Affairs from Wikipedia, the free encyclopedia modified on 7th April available at http,//en.wikipedia.org/wiki/Regulatory_ Affairs.
2. International Regulatory Affairs Updates, 2005. available at http://www.iraup.com/about.php
3. Douglas J Pisano and David S. Mantus. Text book of FDA Regulatory Affairs A Guide for Prescription Drugs, Medical Devices, and Biologics' Second Edition.
4. Regulatory Affairs brought by learning plus, inc. available at http.//www.cgmp.com/ra.htm.

BP 703T. PHARMACY PRACTICE (Theory)

45 Hours

Scope: In the changing scenario of pharmacy practice in India, for successful practice of Hospital Pharmacy, the students are required to learn various skills like drug distribution, drug information, and therapeutic drug monitoring for improved patient care. In community pharmacy, students will be learning various skills such as dispensing of drugs, responding to minor ailments by providing suitable safe medication, patient counselling for improved patient care in the community set up.

Objectives: Upon completion of the course, the student shall be able to

1. know various drug distribution methods in a hospital
2. appreciate the pharmacy stores management and inventory control
3. monitor drug therapy of patient through medication chart review and clinical review
4. obtain medication history interview and counsel the patients
5. identify drug related problems
6. detect and assess adverse drug reactions
7. interpret selected laboratory results (as monitoring parameters in therapeutics) of specific disease states
8. know pharmaceutical care services
9. do patient counseling in community pharmacy;
10. appreciate the concept of Rational drug therapy.

Unit I: **10 Hours**

a) Hospital and it's organization

Definition, Classification of hospital- Primary, Secondary and Tertiary hospitals, Classification based on clinical and non- clinical basis, Organization Structure of a Hospital, and Medical staffs involved in the hospital and their functions.

b) Hospital pharmacy and its organization

Definition, functions of hospital pharmacy, Organization structure, Location, Layout and staff requirements, and Responsibilities and functions of hospital pharmacists.

c) Adverse drug reaction

Classifications - Excessive pharmacological effects, secondary pharmacological effects, idiosyncrasy, allergic drug reactions, genetically determined toxicity, toxicity following sudden withdrawal of drugs, Drug interaction- beneficial interactions, adverse interactions, and pharmacokinetic drug interactions, Methods for detecting

drug interactions, spontaneous case reports and record linkage studies, and Adverse drug reaction reporting and management.

d) Community Pharmacy

Organization and structure of retail and wholesale drug store, types and design, Legal requirements for establishment and maintenance of a drug store, Dispensing of proprietary products, maintenance of records of retail and wholesale drug store.

Unit II: 10 Hours

a) Drug distribution system in a hospital

Dispensing of drugs to inpatients, types of drug distribution systems, charging policy and labelling, Dispensing of drugs to ambulatory patients, and Dispensing of controlled drugs.

b) Hospital formulary

Definition, contents of hospital formulary, Differentiation of hospital formulary and Drug list, preparation and revision, and addition and deletion of drug from hospital formulary.

c) Therapeutic drug monitoring

Need for Therapeutic Drug Monitoring, Factors to be considered during the Therapeutic Drug Monitoring, and Indian scenario for Therapeutic Drug Monitoring.

d) Medication adherence

Causes of medication non-adherence, pharmacist role in the medication adherence, and monitoring of patient medication adherence.

e) Patient medication history interview

Need for the patient medication history interview, medication interview forms.

f) Community pharmacy management

Financial, materials, staff, and infrastructure requirements.

Unit III: 10 Hours

a) Pharmacy and therapeutic committee

Organization, functions, Policies of the pharmacy and therapeutic committee in including drugs into formulary, inpatient and outpatient prescription, automatic stop order, and emergency drug list preparation.

b) Drug information services

Drug and Poison information centre, Sources of drug information, Computerised services, and storage and retrieval of information.

c) Patient counseling

Definition of patient counseling; steps involved in patient counseling, and Special cases that require the pharmacist

d) Education and training program in the hospital

Role of pharmacist in the education and training program, Internal and external training program, Services to the nursing homes/clinics, Code of ethics for community pharmacy, and Role of pharmacist in the interdepartmental communication and community health education.

e) Prescribed medication order and communication skills

Prescribed medication order- interpretation and legal requirements, and Communication skills- communication with prescribers and patients.

Unit IV 8 Hours

a) Budget preparation and implementation

Budget preparation and implementation

b) Clinical Pharmacy

Introduction to Clinical Pharmacy, Concept of clinical pharmacy, functions and responsibilities of clinical pharmacist, Drug therapy monitoring - medication chart review, clinical review, pharmacist intervention, Ward round participation, Medication history and Pharmaceutical care.

Dosing pattern and drug therapy based on Pharmacokinetic & disease pattern.

c) Over the counter (OTC) sales

Introduction and sale of over the counter, and Rational use of common over the counter medications.

Unit V 7 Hours

a) Drug store management and inventory control

Organisation of drug store, types of materials stocked and storage conditions, Purchase and inventory control: principles, purchase procedure, purchase order, procurement and stocking, Economic order quantity, Reorder quantity level, and Methods used for the analysis of the drug expenditure

b) Investigational use of drugs

Description, principles involved, classification, control, identification, role of hospital pharmacist, advisory committee.

c) Interpretation of Clinical Laboratory Tests

Blood chemistry, hematology, and urinalysis

Recommended Books (Latest Edition):

1. Merchant S.H. and Dr. J.S.Quadry. *A textbook of hospital pharmacy*, 4th ed. Ahmadabad: B.S. Shah Prakakshan; 2001.
2. Parthasarathi G, Karin Nyfort-Hansen, Milap C Nahata. *A textbook of Clinical Pharmacy Practice- essential concepts and skills,* 1st ed. Chennai: Orient Longman Private Limited; 2004.
3. William E. Hassan. *Hospital pharmacy*, 5th ed. Philadelphia: Lea & Febiger; 1986.
4. Tipnis Bajaj. *Hospital Pharmacy*, 1st ed. Maharashtra: Career Publications; 2008.
5. Scott LT. *Basic skills in interpreting laboratory data*, 4thed. American Society of Health System Pharmacists Inc; 2009.
6. Parmar N.S. *Health Education and Community Pharmacy,* 18th ed. India: CBS Publishers & Distributers; 2008.

Journals:

1. Therapeutic drug monitoring. ISSN: 0163-4356
2. Journal of pharmacy practice. ISSN : 0974-8326
3. American journal of health system pharmacy. ISSN: 1535-2900 (online)
4. Pharmacy times (Monthly magazine)

BP 704T: NOVEL DRUG DELIVERY SYSTEMS (Theory)

45 Hours

Scope: This subject is designed to impart basic knowledge on the area of novel drug delivery systems.

Objectives: Upon completion of the course student shall be able

1. To understand various approaches for development of novel drug delivery systems.
2. To understand the criteria for selection of drugs and polymers for the development of Novel drug delivery systems, their formulation and evaluation

Course content:

Unit-I **10 Hours**

Controlled drug delivery systems: Introduction, terminology/definitions and rationale, advantages, disadvantages, selection of drug candidates.Approaches to design controlled release formulations based on diffusion, dissolution and ion exchange principles. Physicochemical and biological properties of drugs relevant to controlled release formulations

Polymers: Introduction, classification, properties, advantages and application of polymers in formulation of controlled release drug delivery systems.

Unit-II **10 Hours**

Microencapsulation: Definition, advantages and disadvantages, microspheres /microcapsules, microparticles, methods of microencapsulation, applications

Mucosal Drug Delivery system: Introduction, Principles of bioadhesion / mucoadhesion, concepts, advantages and disadvantages, transmucosal permeability and formulation considerations of buccal delivery systems

Implantable Drug Delivery Systems: Introduction, advantages and disadvantages, concept of implantsand osmotic pump

Unit-III **10 Hours**

Transdermal Drug Delivery Systems: Introduction, Permeation through skin, factors affecting permeation, permeation enhancers, basic components of TDDS, formulation approaches

Gastroretentive drug delivery systems: Introduction, advantages, disadvantages, approaches for GRDDS – Floating, high density systems, inflatable and gastroadhesive systems and their applications

Nasopulmonary drug delivery system: Introduction to Nasal and Pulmonary routes of drug delivery, Formulation of Inhalers (dry powder and metered dose), nasal sprays, nebulizers

Unit-IV **08 Hours**

Targeted drug Delivery: Concepts and approaches advantages and disadvantages, introduction to liposomes, niosomes, nanoparticles, monoclonal antibodies and their applications

Unit-V **07 Hours**

Ocular Drug Delivery Systems: Introduction, intra ocular barriers and methods to overcome –Preliminary study, ocular formulations and ocuserts

Intrauterine Drug Delivery Systems: Introduction, advantages and disadvantages, development of intra uterine devices (IUDs) and applications

Recommended Books: (Latest Editions)

1. Y W. Chien, Novel Drug Delivery Systems, 2nd edition, revised and expanded, Marcel Dekker, Inc., New York, 1992.
2. Robinson, J. R., Lee V. H. L, Controlled Drug Delivery Systems, Marcel Dekker, Inc., New York, 1992.
3. Encyclopedia of Controlled Delivery. Edith Mathiowitz, Published by Wiley Interscience Publication, John Wiley and Sons, Inc, New York. Chichester/Weinheim
4. N.K. Jain, Controlled and Novel Drug Delivery, CBS Publishers & Distributors, New Delhi, First edition 1997 (reprint in 2001).
5. S.P. Vyas and R.K. Khar, Controlled Drug Delivery -concepts and advances, Vallabh Prakashan, New Delhi, First edition 2002.

Journals

1. Indian Journal of Pharmaceutical Sciences (IPA)
2. Indian Drugs (IDMA)
3. Journal of Controlled Release (Elsevier Sciences)
4. Drug Development and Industrial Pharmacy (Marcel & Decker)
5. International Journal of Pharmaceutics (Elsevier Sciences)

SEMESTER VIII

BP801T. BIOSTATISITCS AND RESEARCH METHODOLOGY (Theory)

45 Hours

Scope: To understand the applications of Biostatics in Pharmacy. This subject deals with descriptive statistics, Graphics, Correlation, Regression, logistic regression Probability theory, Sampling technique, Parametric tests, Non Parametric tests, ANOVA, Introduction to Design of Experiments, Phases of Clinical trials and Observational and Experimental studies, SPSS, R and MINITAB statistical software's, analyzing the statistical data using Excel**.**

Objectives: Upon completion of the course the student shall be able to

- Know the operation of M.S. Excel, SPSS, R and MINITAB®, DoE (Design of Experiment)
- Know the various statistical techniques to solve statistical problems
- Appreciate statistical techniques in solving the problems**.**

Course content:

Unit-I **10 Hours**

Introduction: Statistics, Biostatistics, Frequency distribution

Measures of central tendency: Mean, Median, Mode- Pharmaceutical examples

Measures of dispersion: Dispersion, Range, standard deviation, Pharmaceutical problems

Correlation: Definition, Karl Pearson's coefficient of correlation, Multiple correlation - Pharmaceuticals examples

Unit-II **10 Hours**

Regression: Curve fitting by the method of least squares, fitting the lines y= a + bx and x = a + by, Multiple regression, standard error of regression– Pharmaceutical Examples

Probability: Definition of probability, Binomial distribution, Normal distribution, Poisson's distribution, properties - problems

Sample, Population, large sample, small sample, Null hypothesis, alternative hypothesis, sampling, essence of sampling, types of sampling, Error-I type, Error-II type, Standard error of mean (SEM) - Pharmaceutical examples

Parametric test: t-test(Sample, Pooled or Unpaired and Paired) , ANOVA, (One way and Two way), Least Significance difference

Unit-III **10 Hours**

Non Parametric tests: Wilcoxon Rank Sum Test, Mann-Whitney U test, Kruskal-Wallis test, Friedman Test

Introduction to Research: Need for research, Need for design of Experiments, Experiential Design Technique, plagiarism

Graphs: Histogram, Pie Chart, Cubic Graph, response surface plot, Counter Plot graph

Designing the methodology: Sample size determination and Power of a study, Report writing and presentation of data, Protocol, Cohorts studies, Observational studies, Experimental studies, Designing clinical trial, various phases.

Unit-IV **8 Hours**

Blocking and confounding system for Two-level factorials

Regression modeling: Hypothesis testing in Simple and Multiple regressionmodels

Introduction to Practical components of Industrial and Clinical Trials Problems: Statistical Analysis Using Excel, SPSS, MINITAB®, DESIGN OF EXPERIMENTS, R - Online Statistical Software's to Industrial and Clinical trial approach

Unit-V **7Hours**

Design and Analysis of experiments:

Factorial Design: Definition, 2^2, 2^3design. Advantage of factorial design

Response Surface methodology: Central composite design, Historical design, Optimization Techniques

Recommended Books (Latest edition):

1. Pharmaceutical statistics- Practical and clinical applications, Sanford Bolton, publisher Marcel Dekker Inc. NewYork.
2. Fundamental of Statistics – Himalaya Publishing House- S.C.Guptha
3. Design and Analysis of Experiments –PHI Learning Private Limited, R. Pannerselvam,
4. Design and Analysis of Experiments – Wiley Students Edition, Douglas and C. Montgomery

BP 802T SOCIAL AND PREVENTIVE PHARMACY

Hours: 45

Scope:
The purpose of this course is to introduce to students a number of health issues and their challenges. This course also introduced a number of national health programmes. The roles of the pharmacist in these contexts are also discussed.

Objectives:
After the successful completion of this course, the student shall be able to:

- Acquire high consciousness/realization of current issuesrelated to health and pharmaceutical problems within the country and worldwide.
- Have a critical way of thinking based on current healthcare development.
- Evaluate alternative ways of solving problems related tohealth and pharmaceutical issues

Course content:

Unit I: 10 Hours

Concept of health and disease: Definition, concepts and evaluation of public health. Understanding the concept of prevention and control of disease, social causes of diseases and social problems of the sick.

Social and health education: Food in relation to nutrition and health, Balanced diet, Nutritional deficiencies, Vitamin deficiencies, Malnutrition and its prevention.

Sociology and health: Socio cultural factors related to health and disease, Impact of urbanization on health and disease, Poverty and health

Hygiene and health: personal hygiene and health care; avoidable habits

Unit II: 10 Hours

Preventive medicine: General principles of prevention and control of diseases such as cholera, SARS, Ebola virus, influenza, acute respiratory infections, malaria, chicken guinea, dengue, lymphatic filariasis, pneumonia, hypertension, diabetes mellitus, cancer, drug addiction-drug substance abuse

Unit III: 10 Hours

National health programs, its objectives, functioning and outcome of the following: HIV AND AIDS control programme, TB, Integrated disease surveillance program (IDSP), National leprosy control programme, National mental health program, National

programme for prevention and control of deafness, Universal immunization programme, National programme for control of blindness, Pulse polio programme.

Unit IV: **08 Hours**

National health intervention programme for mother and child, National family welfare programme, National tobacco control programme, National Malaria Prevention Program, National programme for the health care for the elderly, Social health programme; role of WHO in Indian national program

Unit V: **07 Hours**

Community services in rural, urban and school health: Functions of PHC, Improvement in rural sanitation, national urban health mission, Health promotion and education in school.

Recommended Books (Latest edition)*:*

1. Short Textbook of Preventive and Social Medicine, Prabhakara GN, 2nd Edition, 2010, ISBN: 9789380704104, JAYPEE Publications
2. Textbook of Preventive and Social Medicine (Mahajan and Gupta), Edited by Roy Rabindra Nath, Saha Indranil, 4th Edition, 2013, ISBN: 9789350901878, JAYPEE Publications
3. Review of Preventive and Social Medicine (Including Biostatistics), Jain Vivek, 6th Edition, 2014, ISBN: 9789351522331, JAYPEE Publications
4. Essentials of Community Medicine—A Practical Approach, Hiremath Lalita D, Hiremath Dhananjaya A, 2nd Edition, 2012, ISBN: 9789350250440, JAYPEE Publications
5. Park Textbook of Preventive and Social Medicine, K Park, 21st Edition, 2011, ISBN-14: 9788190128285, BANARSIDAS BHANOT PUBLISHERS.
6. Community Pharmacy Practice, Ramesh Adepu, BSP publishers, Hyderabad

Recommended Journals:

1. Research in Social and Administrative Pharmacy, Elsevier, Ireland

BP803ET. PHARMA MARKETING MANAGEMENT (Theory)

45 Hours

Scope:

The pharmaceutical industry not only needs highly qualified researchers, chemists and, technical people, but also requires skilled managers who can take the industry forward by managing and taking the complex decisions which are imperative for the growth of the industry. The Knowledge and Know-how of marketing management groom the people for taking a challenging role in Sales and Product management.

Course Objective: The course aims to provide an understanding of marketing concepts and techniques and their applications in the pharmaceutical industry.

Unit I **10 Hours**

Marketing:

Definition, general concepts and scope of marketing; Distinction between marketing & selling; Marketing environment; Industry and competitive analysis; Analyzing consumer buying behavior; industrial buying behavior.

Pharmaceutical market:

Quantitative and qualitative aspects; size and composition of the market; demographic descriptions and socio-psychological characteristics of the consumer; market segmentation& targeting.Consumer profile; Motivation and prescribing habits of the physician; patients' choice of physician and retail pharmacist.Analyzing the Market;Role of market research.

Unit II **10 Hours**

Product decision:

Classification, product line and product mix decisions, product life cycle,product portfolio analysis; product positioning; New product decisions; Product branding, packaging and labeling decisions, Product management in pharmaceutical industry.

Unit III **10 Hours**

Promotion:

Methods, determinants of promotional mix, promotional budget; An overview of personal selling, advertising, direct mail, journals, sampling, retailing, medical exhibition, public relations, online promotional techniques for OTC Products.

Unit IV **10 Hours**

Pharmaceutical marketing channels:

Designing channel, channel members, selecting the appropriate channel, conflict in channels, physical distribution management: Strategic importance, tasks in physical distribution management.

Professional sales representative (PSR):

Duties of PSR, purpose of detailing, selection and training, supervising, norms for customer calls, motivating, evaluating, compensation and future prospects of the PSR.

Unit V **10 Hours**

Pricing:

Meaning, importance, objectives, determinants of price; pricing methods and strategies, issues in price management in pharmaceutical industry. An overview of DPCO (Drug Price Control Order)and NPPA (National Pharmaceutical Pricing Authority).

Emerging concepts in marketing:

Vertical & Horizontal Marketing; RuralMarketing; Consumerism; Industrial Marketing; Global Marketing.

Recommended Books: (Latest Editions)

1. Philip Kotler and Kevin Lane Keller: Marketing Management, Prentice Hall of India, New Delhi
2. Walker, Boyd and Larreche : Marketing Strategy- Planning and Implementation, Tata MC GrawHill, New Delhi.
3. Dhruv Grewal and Michael Levy: Marketing, Tata MC Graw Hill
4. Arun Kumar and N Menakshi: Marketing Management, Vikas Publishing, India
5. Rajan Saxena: Marketing Management; Tata MC Graw-Hill (India Edition)
6. Ramaswamy, U.S & Nanakamari, S: Marketing Managemnt:Global Perspective, IndianContext,Macmilan India, New Delhi.
7. Shanker, Ravi: Service Marketing, Excell Books, New Delhi
8. Subba Rao Changanti, Pharmaceutical Marketing in India (GIFT – Excel series) Excel Publications.

BP804 ET: PHARMACEUTICAL REGULATORY SCIENCE (Theory)

45Hours

Scope: This course is designed to impart the fundamental knowledge on the regulatory requirements for approval of new drugs, and drug products in regulated markets of India & other countries like US, EU, Japan, Australia,UK etc. It prepares the students to learn in detail on the regulatory requirements, documentation requirements, and registration procedures for marketing the drug products.

Objectives: Upon completion of the subject student shall be able to;

1. Know about the process of drug discovery and development
2. Know the regulatory authorities and agencies governing the manufacture and sale of pharmaceuticals
3. Know the regulatory approval process and their registration in Indian and international markets

Course content:

Unit I **10Hours**

New Drug Discovery and development

Stages of drug discovery, Drug development process, pre-clinical studies, non-clinical activities, clinical studies, Innovator and generics, Concept of generics, Generic drug product development.

Unit II **10Hours**

Regulatory Approval Process

Approval processes and timelines involved in Investigational New Drug (IND), New Drug Application (NDA), Abbreviated New Drug Application (ANDA). Changes to an approved NDA / ANDA.

Regulatory authorities and agencies

Overview of regulatory authorities of India, United States, European Union, Australia, Japan, Canada (Organization structure and types of applications)

Unit III **10Hours**

Registration of Indian drug product in overseas market

Procedure for export of pharmaceutical products, Technical documentation, Drug Master Files (DMF), Common Technical Document (CTD), electronic Common Technical

Document (eCTD), ASEAN Common Technical Document (ACTD)research.

Unit IV **08Hours**

Clinical trials

Developing clinical trial protocols, Institutional Review Board / Independent Ethics committee - formation and working procedures, Informed consent process and procedures, GCP obligations of Investigators, sponsors & Monitors, Managing and Monitoring clinical trials, Pharmacovigilance - safety monitoring in clinical trials

Unit V **07Hours**

Regulatory Concepts

Basic terminology, guidance, guidelines, regulations, Laws and Acts, Orange book, Federal Register, Code of Federal Regulatory, Purple book

Recommended books (Latest edition):

1. Drug Regulatory Affairs by Sachin Itkar, Dr. N.S. Vyawahare, Nirali Prakashan.
2. The Pharmaceutical Regulatory Process, Second Edition Edited by Ira R. Berry and Robert P. Martin, Drugs and the Pharmaceutical Sciences,Vol.185. Informa Health care Publishers.
3. New Drug Approval Process: Accelerating Global Registrations By Richard A Guarino, MD, 5th edition, Drugs and the Pharmaceutical Sciences,Vol.190.
4. Guidebook for drug regulatory submissions / Sandy Weinberg. By John Wiley & Sons. Inc.
5. FDA Regulatory Affairs: a guide for prescription drugs, medical devices, and biologics /edited by Douglas J. Pisano, David Mantus.
6. Generic Drug Product Development, Solid Oral Dosage forms, Leon Shargel and Isader Kaufer, Marcel Dekker series, Vol.143
7. Clinical Trials and Human Research: A Practical Guide to Regulatory Compliance By Fay A. Rozovsky and Rodney K. Adams
8. Principles and Practices of Clinical Research, Second Edition Edited by John I. Gallin and Frederick P. Ognibene
9. Drugs: From Discovery to Approval, Second Edition By Rick Ng

BP 805T: PHARMACOVIGILANCE (Theory)

45 hours

Scope: This paper will provide an opportunity for the student to learn about development of pharmacovigilance as a science, basic terminologies used in pharmacovigilance, global scenario of Pharmacovigilance, train students on establishing pharmacovigilance programme in an organization, various methods that can be used to generate safety data and signal detection. This paper also develops the skills of classifying drugs, diseases and adverse drug reactions.

Objectives:

At completion of this paper it is expected that students will be able to (know, do, and appreciate):

1. Why drug safety monitoring is important?
2. History and development of pharmacovigilance
3. National and international scenario of pharmacovigilance
4. Dictionaries, coding and terminologies used in pharmacovigilance
5. Detection of new adverse drug reactions and their assessment
6. International standards for classification of diseases and drugs
7. Adverse drug reaction reporting systems and communication in pharmacovigilance
8. Methods to generate safety data during pre clinical, clinical and post approval phases of drugs' life cycle
9. Drug safety evaluation in paediatrics, geriatrics, pregnancy and lactation
10. Pharmacovigilance Program of India (PvPI) requirement for ADR reporting in India
11. ICH guidelines for ICSR, PSUR, expedited reporting, pharmacovigilance planning
12. CIOMS requirements for ADR reporting
13. Writing case narratives of adverse events and their quality.

Course Content

Unit I **10 Hours**

Introduction to Pharmacovigilance

- History and development of Pharmacovigilance
- Importance of safety monitoring of Medicine
- WHO international drug monitoring programme
- Pharmacovigilance Program of India(PvPI)

Introduction to adverse drug reactions

- Definitions and classification of ADRs
- Detection and reporting
- Methods in Causality assessment
- Severity and seriousness assessment
- Predictability and preventability assessment
- Management of adverse drug reactions

Basic terminologies used in pharmacovigilance

- Terminologies of adverse medication related events
- Regulatory terminologies

Unit II **10 hours**

Drug and disease classification

- Anatomical, therapeutic and chemical classification of drugs
- International classification of diseases
- Daily defined doses
- International Non proprietary Names for drugs

Drug dictionaries and coding in pharmacovigilance

- WHO adverse reaction terminologies
- MedDRA and Standardised MedDRA queries
- WHO drug dictionary
- Eudravigilance medicinal product dictionary

Information resources in pharmacovigilance

- Basic drug information resources
- Specialised resources for ADRs

Establishing pharmacovigilance programme

- Establishing in a hospital
- Establishment & operation of drug safety department in industry
- Contract Research Organisations (CROs)
- Establishing a national programme

Unit III **10 Hours**

Vaccine safety surveillance

- Vaccine Pharmacovigilance
- Vaccination failure
- Adverse events following immunization

Pharmacovigilance methods

- Passive surveillance – Spontaneous reports and case series
- Stimulated reporting
- Active surveillance – Sentinel sites, drug event monitoring and registries
- Comparative observational studies – Cross sectional study, case control study and cohort study
- Targeted clinical investigations

Communication in pharmacovigilance

- Effective communication in Pharmacovigilance
- Communication in Drug Safety Crisis management
- Communicating with Regulatory Agencies, Business Partners, Healthcare facilities & Media

Unit IV **8 Hours**

Safety data generation

- Pre clinical phase
- Clinical phase
- Post approval phase (PMS)

ICH Guidelines for Pharmacovigilance

- Organization and objectives of ICH
- Expedited reporting
- Individual case safety reports
- Periodic safety update reports
- Post approval expedited reporting
- Pharmacovigilance planning
- Good clinical practice in pharmacovigilance studies

Unit V **7 hours**

Pharmacogenomics of adverse drug reactions

- Genetics related ADR with example focusing PK parameters.

Drug safety evaluation in special population

- Paediatrics
- Pregnancy and lactation
- Geriatrics

CIOMS

- CIOMS Working Groups
- CIOMS Form

CDSCO (India) and Pharmacovigilance

- D&C Act and Schedule Y
- Differences in Indian and global pharmacovigilance requirements

Recommended Books (Latest edition):

1. Textbook of Pharmacovigilance: S K Gupta, Jaypee Brothers, Medical Publishers.
2. Practical Drug Safety from A to Z By Barton Cobert, Pierre Biron, Jones and Bartlett Publishers.
3. Mann's Pharmacovigilance:Elizabeth B. Andrews, Nicholas, Wiley Publishers.
4. Stephens' Detection of New Adverse Drug Reactions: John Talbot, Patrick Walle, Wiley Publishers.
5. An Introduction to Pharmacovigilance: Patrick Waller,Wiley Publishers.
6. Cobert's Manual of Drug Safety and Pharmacovigilance: Barton Cobert,Jones& Bartlett Publishers.
7. Textbook of Pharmacoepidemiolog edited by Brian L. Strom, Stephen E Kimmel, Sean Hennessy,Wiley Publishers.
8. A Textbook of Clinical Pharmacy Practice -Essential Concepts and Skills:G. Parthasarathi, Karin NyfortHansen,Milap C. Nahata
9. National Formulary of India
10. Text Book of Medicine by Yashpal Munjal

11. Text book of Pharmacovigilance: concept and practice by GP Mohanta and PK Manna

12. http://www.whoumc.org/DynPage.aspx?id=105825&mn1=7347&mn2=7259&mn3=7297
13. http://www.ich.org/
14. http://www.cioms.ch/
15. http://cdsco.nic.in/
16. http://www.who.int/vaccine_safety/en/
17. http://www.ipc.gov.in/PvPI/pv_home.html

BP 806 ET. QUALITY CONTROL AND STANDARDIZATION OF HERBALS (Theory)

Scope: In this subject the student learns about the various methods and guidelines for evaluation and standardization of herbs and herbal drugs. The subject also provides an opportunity for the student to learn cGMP, GAP and GLP in traditional system of medicines.

Objectives: Upon completion of the subject student shall be able to;

1. know WHO guidelines for quality control of herbal drugs
2. know Quality assurance in herbal drug industry
3. know the regulatory approval process and their registration in Indian and international markets
4. appreciate EU and ICH guidelines for quality control of herbal drugs

Unit I **10 hours**

Basic tests for drugs – Pharmaceutical substances, Medicinal plants materials and dosage forms

WHO guidelines for quality control of herbal drugs.

Evaluation of commercial crude drugs intended for use

Unit II **10 hours**

Quality assurance in herbal drug industry of cGMP, GAP, GMP and GLP in traditional system of medicine.

WHO Guidelines on current good manufacturing Practices (cGMP) for Herbal Medicines

WHO Guidelines on GACP for Medicinal Plants.

Unit III **10 hours**

EU and ICH guidelines for quality control of herbal drugs.

Research Guidelines for Evaluating the Safety and Efficacy of Herbal Medicines

Unit IV **08 hours**

Stability testing of herbal medicines.Application of various chromatographic techniques in standardization of herbal products.

Preparation of documents for new drug application and export registration

GMP requirements and Drugs & Cosmetics Act provisions.

Unit V **07 hours**

Regulatory requirements for herbal medicines.

WHO guidelines on safety monitoring of herbal medicines in pharmacovigilance systems

Comparison of various Herbal Pharmacopoeias.

Role of chemical and biological markers in standardization of herbal products

Recommended Books: (Latest Editions

1. Pharmacognosy by Trease and Evans
2. Pharmacognosy by Kokate, Purohit and Gokhale
3. Rangari, V.D., Text book of Pharmacognosy and Phytochemistry Vol. I , Carrier Pub., 2006.
4. Aggrawal, S.S., Herbal Drug Technology. Universities Press, 2002.
5. EMEA. Guidelines on Quality of Herbal Medicinal Products/Traditional Medicinal Products,
6. Mukherjee, P.W. Quality Control of Herbal Drugs: An Approach to Evaluation of Botanicals. Business Horizons Publishers, New Delhi, India, 2002.
7. Shinde M.V., Dhalwal K., Potdar K., Mahadik K. Application of quality control principles to herbal drugs. International Journal of Phytomedicine 1(2009); p. 4-8.
8. WHO. Quality Control Methods for Medicinal Plant Materials, World Health Organization, Geneva, 1998. WHO. Guidelines for the Appropriate Use of Herbal Medicines. WHO Regional Publications, Western Pacific Series No 3, WHO Regional office for the Western Pacific, Manila, 1998.
9. WHO. The International Pharmacopeia, Vol. 2: Quality Specifications, 3rd edn. World Health Organization, Geneva, 1981.
10. WHO. Quality Control Methods for Medicinal Plant Materials. World Health Organization, Geneva, 1999.
11. WHO. WHO Global Atlas of Traditional, Complementary and Alternative Medicine. 2 vol. set. Vol. 1 contains text and Vol. 2, maps. World Health Organization, Geneva, 2005.
12. WHO. Guidelines on Good Agricultural and Collection Practices (GACP) for Medicinal Plants. World Health Organization, Geneva, 2004.

BP 807 ET. COMPUTER AIDED DRUG DESIGN (Theory)

45 Hours

Scope: This subject is designed to provide detailed knowledge of rational drug design process and various techniques used in rational drug design process.

Objectives: Upon completion of the course, the student shall be able to understand

- Design and discovery of lead molecules
- The role of drug design in drug discovery process
- The concept of QSAR and docking
- Various strategies to develop new drug like molecules.
- The design of new drug molecules using molecular modeling software

Course Content:

UNIT-I **10 Hours**

Introduction to Drug Discovery and Development

Stages of drug discovery and development

Lead discovery and Analog Based Drug Design

Rational approaches to lead discovery based on traditional medicine, Random screening, Non-random screening, serendipitous drug discovery, lead discovery based on drug metabolism, lead discovery based on clinical observation.

Analog Based Drug Design: Bioisosterism, Classification, Bioisosteric replacement. Any three case studies

UNIT-II **10 Hours**

Quantitative Structure Activity Relationship (QSAR)

SAR versus QSAR, History and development of QSAR, Types of physicochemical parameters, experimental and theoretical approaches for the determination of physicochemical parameters such as Partition coefficient, Hammet's substituent constant and Tafts steric constant. Hansch analysis, Free Wilson analysis, 3D-QSAR approaches like COMFA and COMSIA.

UNIT-III **10 Hours**

Molecular Modeling and virtual screening techniques

Virtual Screening techniques: Drug likeness screening, Concept of pharmacophore mapping and pharmacophore based Screening,

Molecular docking: Rigid docking, flexible docking, manual docking, Docking based screening. *De novo* drug design.

UNIT-IV **08 Hours**

Informatics & Methods in drug design

Introduction to Bioinformatics, chemoinformatics. ADME databases, chemical, biochemical and pharmaceutical databases.

UNIT-V **07 Hours**

Molecular Modeling: Introduction to molecular mechanics and quantum mechanics.Energy Minimization methods and Conformational Analysis, global conformational minima determination.

Recommended Books (Latest Editions)

1. Robert GCK, ed., "Drug Action at the Molecular Level" University Prak Press Baltimore.
2. Martin YC. "Quantitative Drug Design" Dekker, New York.
3. Delgado JN, Remers WA eds "Wilson & Gisvolds's Text Book of Organic Medicinal & Pharmaceutical Chemistry" Lippincott, New York.
4. Foye WO "Principles of Medicinal chemistry 'Lea & Febiger.
5. Koro lkovas A, Burckhalter JH. "Essentials of Medicinal Chemistry" Wiley Interscience.
6. Wolf ME, ed "The Basis of Medicinal Chemistry, Burger's Medicinal Chemistry" John Wiley & Sons, New York.
7. Patrick Graham, L., An Introduction to Medicinal Chemistry, Oxford University Press.
8. Smith HJ, Williams H, eds, "Introduction to the principles of Drug Design" Wright Boston.
9. Silverman R.B. "The organic Chemistry of Drug Design and Drug Action" Academic Press New York.

BP808ET: CELL AND MOLECULAR BIOLOGY (Elective subject)

45 Hours

Scope:

- Cell biology is a branch of biology that studies cells – their physiological properties, their structure, the organelles they contain, interactions with their environment, their life cycle, division, death and cell function.
- This is done both on a microscopic and molecular level.
- Cell biology research encompasses both the great diversity of single-celled organisms like bacteria and protozoa, as well as the many specialized cells in multi-cellular organismssuch as humans, plants, and sponges.

Objectives: Upon completion of the subject student shall be able to;

- Summarize cell and molecular biology history.
- Summarize cellular functioning and composition.
- Describe the chemical foundations of cell biology.
- Summarize the DNA properties of cell biology.
- Describe protein structure and function.
- Describe cellular membrane structure and function.
- Describe basic molecular genetic mechanisms.
- Summarize the Cell Cycle

Course content:

Unit I **10Hours**

a) Cell and Molecular Biology: Definitions theory and basics and Applications.
b) Cell and Molecular Biology: History and Summation.
c) Properties of cells and cell membrane.
d) Prokaryotic versus Eukaryotic
e) Cellular Reproduction
f) Chemical Foundations – an Introduction and Reactions (Types)

Unit II **10 Hours**

a) DNA and the Flow of Molecular Information
b) DNA Functioning
c) DNA and RNA
d) Types of RNA
e) Transcription and Translation

Unit III **10 Hours**

a) Proteins: Defined **and** Amino Acids
b) Protein Structure

c) Regularities in Protein Pathways
d) Cellular Processes
e) Positive Control and significance of Protein Synthesis

Unit IV **08 Hours**

a) Science of Genetics
b) Transgenics and Genomic Analysis
c) Cell Cycle analysis
d) Mitosis and Meiosis
e) Cellular Activities and Checkpoints

Unit V **07 Hours**

a) Cell Signals: Introduction
b) Receptors for Cell Signals
c) Signaling Pathways: Overview
d) Misregulation of Signaling Pathways
e) Protein-Kinases: Functioning

Recommended Books (latest edition):

1. W.B. Hugo and A.D. Russel: Pharmaceutical Microbiology, Blackwell Scientific publications, Oxford London.
2. Prescott and Dunn., Industrial Microbiology, 4th edition, CBS Publishers & Distributors, Delhi.
3. Pelczar, Chan Kreig, Microbiology, Tata McGraw Hill edn.
4. Malcolm Harris, Balliere Tindall and Cox: Pharmaceutical Microbiology.
5. Rose: Industrial Microbiology.
6. Probisher, Hinsdill et al: Fundamentals of Microbiology, 9th ed. Japan
7. Cooper and Gunn's: Tutorial Pharmacy, CBS Publisher and Distribution.
8. Peppler: Microbial Technology.
9. Edward: Fundamentals of Microbiology.
10. N.K.Jain: Pharmaceutical Microbiology, Vallabh Prakashan, Delhi
11. Bergeys manual of systematic bacteriology, Williams and Wilkins- A Waverly company
12. B.R. Glick and J.J. Pasternak: Molecular Biotechnology: Principles and Applications of RecombinantDNA: ASM Press Washington D.C.
13. RA Goldshy et. al., : Kuby Immunology.

BP809ET. COSMETIC SCIENCE(Theory)

45Hours

UNIT I **10Hours**

Classification of cosmetic and cosmeceutical products

Definition of cosmetics as per Indian and EU regulations, Evolution of cosmeceuticals from cosmetics, cosmetics as quasi and OTC drugs

Cosmetic excipients: Surfactants, rheology modifiers, humectants, emollients, preservatives. Classification and application

Skin: Basic structure and function of skin.

Hair: Basic structure of hair. Hair growth cycle.

Oral Cavity: Common problem associated with teeth and gums**.**

UNIT II **10 Hours**

Principles of formulation and building blocks of skin care products:

Face wash,

Moisturizing cream, Cold Cream, Vanishing cream and their advantages and disadvantages.Application of these products in formulation of cosmecuticals.

Antiperspants & deodorants- Actives & mechanism of action.

Principles of formulation and building blocks of Hair care products:

Conditioning shampoo, Hair conditioner,anti-dandruff shampoo.

Hair oils.

Chemistry and formulation of Para-phylene diamine based hair dye.

Principles of formulation and building blocks of oral care products:

Toothpaste for bleeding gums, sensitive teeth. Teeth whitening, Mouthwash.

UNIT III **10 Hours**

Sun protection, Classification of Sunscreens and SPF.

Role of herbs in cosmetics:

Skin Care: Aloe and turmeric

Hair care: Henna and amla.

Oral care: Neem and clove

Analytical cosmetics: BIS specification and analytical methods for shampoo, skin-cream and toothpaste**.**

UNIT IV **08 Hours**.

Principles of Cosmetic Evaluation:Principles of sebumeter, corneometer. Measurement of TEWL, Skin Color, Hair tensile strength, Hair combing properties

Soaps,and syndet bars. Evolution and skin benfits.

UNIT V **07 Hours**

Oily and dry skin, causes leading to dry skin, skin moisturisation. Basic understanding of the terms Comedogenic, dermatitis.

Cosmetic problems associated with Hair and scalp: Dandruff, Hair fall causes

Cosmetic problems associated with skin: blemishes, wrinkles, acne, prickly heat and body odor.

Antiperspirants and Deodorants- Actives and mechanism of action

References

1) Harry's Cosmeticology, Wilkinson, Moore, Seventh Edition, George Godwin.
2) Cosmetics – Formulations, Manufacturing and Quality Control, P.P. Sharma, 4th Edition, Vandana Publications Pvt. Ltd., Delhi.
3) Text book of cosmelicology by Sanju Nanda & Roop K. Khar, Tata Publishers.

BP810 ET. PHARMACOLOGICAL SCREENING METHODS

45 Hours

Scope: This subject is designed to impart the basic knowledge of preclinical studies in experimental animals including design, conduct and interpretations of results.

Objectives

Upon completion of the course the student shall be able to,

- Appreciate the applications of various commonly used laboratory animals.
- Appreciate and demonstrate the various screening methods used in preclinical research
- Appreciate and demonstrate the importance of biostatistics and researchmethodology
- Design and execute a research hypothesis independently

Unit –I	**08 Hours**
Laboratory Animals: Study of CPCSEA and OECD guidelines for maintenance, breeding and conduct of experiments on laboratory animals, Common lab animals: Description and applications of different species and strains of animals. Popular transgenic and mutant animals. Techniques for collection of blood and common routes of drug administration in laboratory animals, Techniques of blood collection and euthanasia.	
Unit –II	**10 Hours**
Preclinical screening models a. Introduction: Dose selection, calculation and conversions, preparation of drug solution/suspensions, grouping of animals and importance of sham negative and positive control groups. Rationale for selection of animal species and sex for the study. b. **Study of screening animal models for** Diuretics, nootropics, anti-Parkinson's,antiasthmatics, **Preclinical screening models:** for CNS activity- analgesic, antipyretic,anti-inflammatory, general anaesthetics, sedative and hypnotics, antipsychotic, antidepressant, antiepileptic, antiparkinsonism, alzheimer's disease	

Unit –III **Preclinical screening models:** for ANS activity, sympathomimetics, sympatholytics, parasympathomimetics, parasympatholytics, skeletal muscle relaxants, drugs acting on eye, local anaethetics	
Unit –IV **Preclinical screening models:** for CVS activity- antihypertensives, diuretics, antiarrhythmic, antidyslepidemic, anti aggregatory, coagulants, and anticoagulants Preclinical screening models for other important drugs like antiulcer, antidiabetic, anticancer and antiasthmatics.	
Research methodology and Bio-statistics Selection of research topic, review of literature, research hypothesis and study design Pre-clinical data analysis and interpretation using Students 't' test and One-way ANOVA. Graphical representation of data	**05 Hours**

Recommended Books (latest edition):

1. Fundamentals of experimental Pharmacology-by M.N.Ghosh
2. Hand book of Experimental Pharmacology-S.K.Kulakarni
3. CPCSEA guidelines for laboratory animal facility.
4. Drug discovery and Evaluation by Vogel H.G.
5. Drug Screening Methods by Suresh Kumar Gupta and S. K. Gupta
6. Introduction to biostatistics and research methods by PSS Sundar Rao and J Richard

BP 811 ET. ADVANCED INSTRUMENTATION TECHNIQUES

45 Hours

Scope: This subject deals with the application of instrumental methods in qualitative and quantitative analysis of drugs. This subject is designed to impart advanced knowledge on the principles and instrumentation of spectroscopic and chromatographic hyphenated techniques. This also emphasizes on theoretical and practical knowledge on modern analytical instruments that are used for drug testing.

Objectives: Upon completion of the course the student shall be able to

- understand the advanced instruments used and its applications in drug analysis
- understand the chromatographic separation and analysis of drugs.
- understand the calibration of various analytical instruments
- know analysis of drugs using various analytical instruments.

Course Content:

UNIT-I **10 Hours**

Nuclear Magnetic Resonance spectroscopy

Principles of H-NMR and C-NMR, chemical shift, factors affecting chemical shift, coupling constant, Spin - spin coupling, relaxation, instrumentation and applications

Mass Spectrometry- Principles, Fragmentation, Ionization techniques – Electron impact, chemical ionization, MALDI, FAB, Analyzers-Time of flight and Quadrupole, instrumentation, applications

UNIT-II **10 Hours**

Thermal Methods of Analysis: Principles, instrumentation and applications of ThermogravimetricAnalysis (TGA), Differential Thermal Analysis (DTA), Differential Scanning Calorimetry (DSC)

X-Ray Diffraction Methods: Origin of X-rays, basic aspects of crystals, X-ray

Crystallography, rotating crystal technique, single crystal diffraction,powder diffraction, structural elucidation and applications.

UNIT-III **10 Hours**

Calibration and validation-as per ICH and USFDA guidelines

Calibration of following Instruments

Electronic balance, UV-Visible spectrophotometer, IR spectrophotometer,

Fluorimeter, Flame Photometer, HPLC and GC

UNIT-IV **08 Hours**

Radio immune assay: Importance, various components, Principle, different methods, Limitation and Applications of Radio immuno assay

Extraction techniques:General principle and procedure involved in the solid phase extraction and liquid-liquid extraction

UNIT-V **07 Hours**

Hyphenated techniques-LC-MS/MS, GC-MS/MS, HPTLC-MS.

Recommended Books (Latest Editions)

1. Instrumental Methods of Chemical Analysis by B.K Sharma
2. Organic spectroscopy by Y.R Sharma
3. Text book of Pharmaceutical Analysis by Kenneth A. Connors
4. Vogel's Text book of Quantitative Chemical Analysis by A.I. Vogel
5. Practical Pharmaceutical Chemistry by A.H. Beckett and J.B. Stenlake
6. Organic Chemistry by I. L. Finar
7. Organic spectroscopy by William Kemp
8. Quantitative Analysis of Drugs by D. C. Garrett
9. Quantitative Analysis of Drugs in Pharmaceutical Formulations by P. D. Sethi
10. Spectrophotometric identification of Organic Compounds by Silverstein

BP 812 ET. DIETARY SUPPLEMENTS AND NUTRACEUTICALS

No. of hours :3 **Tutorial:1** **Credit point:4**

Scope :

This subject covers foundational topic that are important for understanding the need and requirements of dietary supplements among different groups in the population.

Objective:

This module aims to provide an understanding of the concepts behind the theoretical applications of dietary supplements. By the end of the course, students should be able to :

1. Understand the need of supplements by the different group of people to maintain healthy life.
2. Understand the outcome of deficiencies in dietary supplements.
3. Appreciate the components in dietary supplements and the application.
4. Appreciate the regulatory and commercial aspects of dietary supplements including health claims.

UNIT I **07 hours**

a. Definitions of Functional foods, Nutraceuticals and Dietary supplements. Classification of Nutraceuticals, Health problems and diseases that can be prevented or cured by Nutraceuticals i.e. weight control, diabetes, cancer, heart disease, stress, osteoarthritis, hypertension etc.
b. Public health nutrition, maternal and child nutrition, nutrition and ageing, nutrition education in community.
c. Source, Name of marker compounds and their chemical nature, Medicinal uses and health benefits of following used as nutraceuticals/functional foods: Spirulina, Soyabean, Ginseng, Garlic, Broccoli, Gingko, Flaxseeds

UNIT II **15 hours**

Phytochemicals as nutraceuticals: Occurrence and characteristic features(chemical nature medicinal benefits) of following

a) Carotenoids- α and β-Carotene, Lycopene, Xanthophylls, leutin
b) Sulfides: Diallyl sulfides, Allyl trisulfide.
c) Polyphenolics: Reservetrol
d) Flavonoids- Rutin , Naringin, Quercitin, Anthocyanidins, catechins, Flavones
e) Prebiotics / Probiotics.: Fructo oligosaccharides, Lacto bacillum
f) Phyto estrogens : Isoflavones, daidzein, Geebustin, lignans
g) Tocopherols
h) Proteins, vitamins, minerals, cereal, vegetables and beverages as functional foods: oats, wheat bran, rice bran, sea foods, coffee, tea and the like.

UNIT III **07 hours**

a) Introduction to free radicals: Free radicals, reactive oxygen species, production of free radicals in cells, damaging reactions of free radicals on lipids, proteins, Carbohydrates, nucleic acids.

b) Dietary fibres and complex carbohydrates as functional food ingredients..

UNIT IV **10 hours**

a) Free radicals in Diabetes mellitus, Inflammation, Ischemic reperfusion injury, Cancer, Atherosclerosis, Free radicals in brain metabolism and pathology, kidney damage, muscle damage. Free radicals involvement in other disorders. Free radicals theory of ageing.

b) Antioxidants: Endogenous antioxidants – enzymatic and nonenzymatic antioxidant defence, Superoxide dismutase, catalase, Glutathione peroxidase, Glutathione Vitamin C, Vitamin E, α- Lipoic acid, melatonin
Synthetic antioxidants: Butylated hydroxy Toluene, Butylated hydroxy Anisole.

c) Functional foods for chronic disease prevention

UNIT V **06 hours**

a) Effect of processing, storage and interactions of various environmental factors on the potential of nutraceuticals.

b) Regulatory Aspects; FSSAI, FDA, FPO, MPO, AGMARK. HACCP and GMPs on Food Safety. Adulteration of foods.

c) Pharmacopoeial Specifications for dietary supplements and nutraceuticals.

References:

1. Dietetics by Sri Lakshmi
2. Role of dietary fibres and neutraceuticals in preventing diseases by K.T Agusti and P.Faizal: BSPunblication.
3. Advanced Nutritional Therapies by Cooper. K.A., (1996).
4. The Food Pharmacy by Jean Carper, Simon & Schuster, UK Ltd., (1988).
5. Prescription for Nutritional Healing by James F.Balch and Phyllis A.Balch 2nd Edn., Avery Publishing Group, NY (1997).
6. G. Gibson and C.williams Editors *2000 Functional foods* Woodhead Publ.Co.London.
7. Goldberg, I. *Functional Foods*. 1994. Chapman and Hall, New York.
8. Labuza, T.P. 2000 Functional Foods and Dietary Supplements: Safety, Good Manufacturing Practice (GMPs) and Shelf Life Testing in *Essentials of Functional Foods* M.K. Sachmidl and T.P. Labuza eds. Aspen Press.
9. Handbook of Nutraceuticals and Functional Foods, Third Edition (Modern Nutrition)
10. Shils, ME, Olson, JA, Shike, M. 1994 *Modern Nutrition in Health and Disease*. Eighth edition. Lea and Febiger

Semester VIII – Elective course on Pharmaceutical Product Development

No of Hours: 3 Tutorial:1 Credit points:4

Unit-I **10 Hours**

Introduction to pharmaceutical product development, objectives, regulations related to preformulation, formulation development, stability assessment, manufacturing and quality control testing of different types of dosage forms

Unit-II **10 Hours**

An advanced study of Pharmaceutical Excipients in pharmaceutical product development with a special reference to the following categories

i. Solvents and solubilizers
ii. Cyclodextrins and their applications
iii. Non - ionic surfactants and their applications
iv. Polyethylene glycols and sorbitols
v. Suspending and emulsifying agents
vi. Semi solid excipients

Unit-III **10 Hours**

An advanced study of Pharmaceutical Excipients in pharmaceutical product development with a special reference to the following categories

i. Tablet and capsule excipients
ii. Directly compressible vehicles
iii. Coat materials
iv. Excipients in parenteral and aerosols products
v. Excipients for formulation of NDDS

Selection and application of excipients in pharmaceutical formulations with specific industrial applications

Unit-IV **08 Hours**

Optimization techniques in pharmaceutical product development.A study of various optimization techniques for pharmaceutical product development with specific examples.Optimization by factorial designs and their applications.A study of QbD and its application in pharmaceutical product development.

Unit-V **07 Hours**

Selection and quality control testing of packaging materials for pharmaceutical product development- regulatory considerations.

Recommended Books (Latest editions)

1. Pharmaceutical Statistics Practical and Clinical Applications by Stanford Bolton, CharlesBon; Marcel Dekker Inc.
2. Encyclopedia of Pharmaceutical Technology, edited by James swarbrick, Third Edition,Informa Healthcare publishers.
3. Pharmaceutical Dosage Forms, Tablets, Volume II, edited by Herbert A. Lieberman andLeon Lachman; Marcel Dekker, Inc.
4. The Theory and Practice of Industrial Pharmacy, Fourth Edition, edited by Roop kKhar, S P Vyas, Farhan J Ahmad, Gaurav K Jain; CBS Publishers and Distributors Pvt.Ltd. 2013.
5. Martin's Physical Pharmacy and Pharmaceutical Sciences, Fifth Edition, edited by Patrick J. Sinko, BI Publications Pvt. Ltd.
6. Targeted and Controlled Drug Delivery, Novel Carrier Systems by S. P. Vyas and R. K.Khar, CBS Publishers and Distributors Pvt. Ltd, First Edition 2012.
7. Pharmaceutical Dosage Forms and Drug Delivery Systems, Loyd V. Allen Jr., Nicholas B.Popovich, Howard C. Ansel, 9th Ed. 40
8. Aulton's Pharmaceutics – The Design and Manufacture of Medicines, Michael E. Aulton,3rd Ed.
9. Remington – The Science and Practice of Pharmacy, 20th Ed.
10. Pharmaceutical Dosage Forms – Tablets Vol 1 to 3, A. Liberman, Leon Lachman andJoseph B. Schwartz
11. Pharmaceutical Dosage Forms – Disperse Systems Vol 1 to 3, H.A. Liberman, Martin, M.R and Gilbert S. Banker.
12. Pharmaceutical Dosage Forms – Parenteral Medication Vol 1 & 2, Kenneth E. Avis andH.A. Libermann.
13. Advanced Review Articles related to the topics.

CONTENTS

Pharmacy Council of India (PCI) Notifications

[PUBLISHED IN THE GAZETTE OF INDIA, No.19, PART III, SECTION 4]

Ministry of Health and Family Welfare
(Pharmacy Council of India)

New Delhi, 10th May, 2008.

PHARM.D. REGULATIONS 2008

Regulations framed under section 10 of the Pharmacy Act, 1948 (8 of 1948). (As approved by the Government of India, Ministry of Health vide, letter No.V.13013/1/2007-PMS, dated the 13th March, 2008 and notified by the Pharmacy Council of India).

No.14-126/2007-PCI- In exercise of the powers conferred by section 10 of the Pharmacy Act, 1948 (8 of 1948), the Pharmacy Council of India, with the approval of the Central Government, hereby makes the following regulations, namely:-

1. Short title and commencement -
   (i) These regulations may be called the Pharm.D. Regulations 2008.
   (ii) They shall come into force from the date of their publication in theofficial Gazette.
2. Pharm.D. shall consist of a certificate, having passed the course of study and examination as prescribed in these regulations, for the purpose of registration as a pharmacist to practice the profession under the Pharmacy Act, 1948.

Institute of Pharmacy and Paramedical Sciences, Agra

(Dr. Bhim Rao Ambedkar University, Agra)

Preamble:

Institute of Pharmacy and Paramedical Sciences, Dr. Bhim Rao Ambedkar University, Agra imparting education and training in pharmaceutical sciences since 2002, started B. Pharm course in 2002. Pharm D (Post Baccalaureate), M.Pharm, D.Pharm programs were introduced in 2021. From the year 2002- 20, the institute was named as Department of pharmacy and in the year 2020 its name was changed to Institute of Pharmacy and Paramedical Sciences. The regulations for the Pharm.D. and Pharm.D. (Post Baccalaureate) programmes are formulated as under:

1. Introduction:

1.1. These regulations shall be called the University Regulations for Pharm.D. and Pharm.D. (Post Baccalaureate) programme and govern the policies and procedures including selection, admission, imparting of instructions, conduct of examinations, evaluation and certification of candidate's performance and all amendments thereto, leading to the award of Pharm.D. and Pharm.D. (Post Baccalaureate) degree. The regulations shall come into effect from the academic year 2016-2017.

1.2. This set of regulations shall be binding on all the candidates undergoing the said degree programme.

1.3. These regulations may be modified from time to time as mandated by the statutes of the University and the Pharmacy Council of India.

1.4. This set of regulations may evolve and get refined or updated or amended or modified or changed through appropriate approvals from the Academic Council or the Board of Management from time to time and shall be binding on all parties concerned including the Candidates, Faculty, Staff, Departments and Institute Authorities.

1.5. All disputes arising from this set of regulations shall be addressed to the Board of Management. The decision of the Board of Management is final and binding on all parties concerned. Further, any legal disputes arising out of this set of regulations shall be limited to the jurisdiction of Courts of Agra only.

2. Definitions:

Unless the context otherwise requires

- *BOM means Board of Management*
- *AC means Academic Council*
- *BOS means Board of Studies (UG and PG) in Pharmaceutical Sciences*
- *College/Institute means Institute of Pharmacy and Paramedical Sciences, Agra*
- *He includes both genders He and She; similarly his and / or him, himself includes her, as well in all cases.*
- *Head of the Institution means the Dean / Principal of the College Institute of Pharmacy and Paramedical Sciences, Agra*
- *Regulations means this set of academic regulations*
- *Regulatory Authority – Authority appointed / constituted by the central /state governments/s to regulate Pharmaceutical Sciences Education.*
- *Teaching Hospital means S.N. MEDICAL COLLEGE,AGRA.*
- *University means Institute of Pharmacy and Paramedical Sciences, Agra*
- *She means both he and she*

3. Duration of the Course:

a) **Pharm.D:** The duration of the course shall be six academic years (five years of study and one year of internship or residency) full time with each academic year spread over a period of not less than two hundred working days. The period of six years duration is divided into two phases-

Phase I - consisting of First, Second, Third, Fourth and Fifth academic year.

Phase II - consisting of internship or residency training in the sixth yearinvolving posting in specialty units.

b) **Pharm.D (Post Baccalaureate):** The duration of the course shall be for three academic years (two years of study and one year internship or residency) full time with each academic year spread over a period of not less than two hundred working days. The period of three years durationis divided into two phases –
Phase I- consisting of First and Second academic year.

Phase II - consisting of Internship or residency training during the thirdyear involving posting in specialty units.

4. Medium of Instruction and Examinations:

The medium of Instruction and Examination shall be English.

5. Maximum Period for completion of the course:

The maximum period for completion of the Pharm.D course is twelve years andPharm.D. (Post Baccalaureate) course is six years.

6. Eligibility for Admissions:

6.1 Pharm.D.

Eligibility criteria for admission to Pharm.D. Course is

1. The student has completed the age of 17 years on or before the 31st December of the year of admission
2. She has passed the two year PUC examination of the Karnataka PUE Board or an examination considered equivalent by Institute of Pharmacy and Paramedical Sciences, Agra with not less than 45% marks with Physics and Chemistry as compulsory subjects along with one of the following subjects - Mathematics or Biology.

OR

A pass in D.Pharm course from an institution approved by the Pharmacy Council of India under section 12 of the Pharmacy Act.

OR

Any other qualification approved by PCI as equivalent to any of theabove examinations

6.2 Pharm.D. (Post Baccalaureate)

A pass in B.Pharm with 50% mark from an institution approved by the Pharmacy Council of India under section 12 of the Pharmacy Act. The candidate shall be admitted to IV year of the course(lateralentry)which

shall be in effect the first year of the Pharm.D (Post Baccalaureate)course.

7. Selection of eligible candidates:

Selection to the Pharm.D. and Pharm.D. (Post Baccalaureate) course shall bebased on merit obtained in the qualifying examination.

8. Withdrawal -Temporary and Permanent:

8.1. Temporary Withdrawal:

8.1.1. A candidate who has been admitted to the course may be permittedto withdraw temporarily for a period of six months or more up to one year on the grounds of prolonged illness, grave calamity in the family etc., provided:

a) He applies stating the reason of withdrawal with supporting documents and endorsement by parent/guardian.

b) The College is satisfied that without counting the period of withdrawal candidate is likely to complete his requirement of the degree within maximum time specified.

c) There are no outstanding dues or demands with the department,library, hostel, College etc.

8.1.2. The tuition fee for the subsequent year may be collected in advance based on the severity of the case before giving approval for any suchtemporary withdrawal.

8.1.3. Scholarship holders are bound by the appropriate rules applicable

8.1.4. The decision of the Institute/University regarding withdrawal of a candidate is final and binding.

8.2. Withdrawal of Admission:

8.2.1. As per University/ UGC norms.

addition to those mentioned in the clause above.

8.2.2. The decision of the college/university regarding withdrawal of acandidate is final and binding.

9. Conduct and discipline:

9.1. Candidates shall conduct themselves within and outside the premises of the Institute in a manner befitting the student of a professional Institution.

9.2. As per the order of Honorable Supreme Court of India, ragging in any formis considered as a criminal offence and is banned. Any form of ragging willbe severely dealt with.

9.3. The following act of omission and/or commission shall constitute gross violation of the code of conduct and are liable to invoke disciplinarymeasures:

9.3.1. Ragging as defined and described by the SupremeCourt/Government

9.3.2. Lack of courtesy and decorum; indecent behavior anywhere withinor outside the campus.

9.3.3. Willful damage or stealthy removal of any property/belongings ofthe Institute/Hostel or of fellow candidates/citizens.

9.3.4. Possession, consumption or distribution of alcoholic drinks or anykind of hallucinogenic drugs.

9.3.5. Mutilation or unauthorized possession of library books.

9.3.6. Noisy or unseemly behavior, disturbing studies of fellow candidates.

9.3.7. Hacking in computer systems (such as entering into other person's domain without prior permission, manipulation and/or damage to the computer hardware and software or any other cyber crime etc.)

9.3.8. Plagiarism of any nature.

9.3.9. Any other act of gross indiscipline as decided by the Board of management from time to time.

9.4. Commensurate with the gravity of offence, the punishment may be: reprimand, fine, expulsion from the hostel, debarment from an examination, disallowing the use of certain facilities of the College, rustication for a specific period or even outright expulsion from the College, or even handing over the case to appropriate law enforcement authorities or the judiciary, as required by the circumstances.

9.5. For any offence committed in (i) a hostel (ii) a department or in a

classroom and elsewhere, the Chief Warden, the Head of the Department and the Head of the Institute, respectively, shall have the authority to reprimand or impose fine.

9.6. All cases involving punishment other than reprimand shall be reported to the Vice- chancellor.

9.7. Cases of adoption of unfair means and/or any malpractice in an examination shall be reported to the Dean (Academic Affairs) for taking appropriate action.

10. Graduation Requirements:

A Candidate shall be declared eligible for the award of the degree if he has:

- Fulfilled degree requirements including internship or residency training.
- No dues to the University, Institute, Departments, Hostels, Library, etc.
- No disciplinary action pending against him.

The award of the degree must be recommended by the Board of Management.

11. Convocation:

Degrees will be awarded in person for the candidates who have graduated during the preceding academic year. Degrees will be awarded *in absentia* to such candidates who are unable to attend the convocation. Candidates are required to apply for the convocation along with prescribed fee within the specified date, after having satisfactorily completed all degree requirements of the course.

Provisional pass certificate will be issued by the University provided the candidate fulfills requirements mentioned in clause (10) above. The provisional certificate will be issued on submission of an application through the college and will be valid until the convocation.

12. Academic Appeals Board (AAB)

There shall be an Academic Appeals Boards constituted by the college and approved by the University

Constitution:

- Head of the institution of a constituent college : Chairman
- A Professor from a constituent college : Member
  (Nominated by the Vice-Chancellor)
- Three faculty members : Members
  (Nominated by the Head of the institution)

- Controller of Examination : Member Secretary

Note:

i The Chairman may co-opt and/or invite more members.

ii The senior most member in the Board shall act as chairman in theabsence of chairperson

iii The quorum of each meeting shall be a minimum of Four

Functions of the Board:

- To receive grievance/ complaints in writing from the students regarding anomaly in award of marks due to bias, victimization, erratic evaluation, etc. and redress the complaints.
- To interact with the concerned teacher and the student separately, before takingthe decision.
- The decision of the AAB will be based on simple majority.
- The recommendation of the AAB shall be communicated to theUniversity for further appropriate action

13. Subjects of Study and Training:

13.1 Pharm.D.

Subjects of study and examination scheme for first to sixth year Pharm.D. aregiven in Tables.

TABLES

First Year:

Subject Code	Name of Subject	No. of hours/ Week	No. of hours of Tutorial
(1)	2	(3)	(4)
22PD11T	Human Anatomy and Physiology	3	1
22PD11P	Human Anatomy and Physiology	3	-
22PD12T	Pharmaceutics	2	1
22PD12P	Pharmaceutics	3	-
22PD13T	Medicinal Biochemistry	3	1
22PD13P	Medicinal Biochemistry	3	-
22PD14T	Pharmaceutical Organic Chemistry	3	1
22PD14P	Pharmaceutical Organic Chemistry	3	-
22PD15T	Pharmaceutical Inorganic Chemistry	2	1

22PD15P	Pharmaceutical Inorganic Chemistry	3	-
22PD16T*	Remedial Mathematics^{+}/ Biology^{++}	3	1
22PD16P*	Remedial Biology^{++}	3	-
22PD17T*	Constitution of India	2	-
		$33^{+}/36^{++}/30$	6
	Total hours - For Maths Deficient: 39For Biology Deficient: 42 For No Maths/Bio Deficiency: 35		

+ For mathematics deficit students ++ For Biology deficit students

* College examination only

Second Year:

Subject Code	Name of Subject	No. of hours/ Week	No. of hours of Tutorial
22PD21T	Pathophysiology	3	1
22PD22T	Pharmaceutical Microbiology	3	1
22PD22P	Pharmaceutical Microbiology	3	-
22PD23T	Pharmacognosy & Phytopharmaceuticals	3	1
22PD23P	Pharmacognosy & Phytopharmaceuticals	3	-
22PD24T	Pharmacology-I	3	1
22PD25T	Community Pharmacy	2	1
22PD26T	Pharmacotherapeutics-I	3	1
22PD26P	Pharmacotherapeutics-I	3	-
22PD27T*	Human Rights, Gender Equity and Environmental Studies	2	-
	Total hours	**28**	**6**
	Grand Total	**34**	

* College examination only

Third Year:

Subject Code	Name of Subject	No. of hours/ Week	No. of hours of Tutorial
22PD31T	Pharmacology-II	3	1
22PD31P	Pharmacology-II	3	-
22PD32T	Pharmaceutical Analysis	3	1
22PD32P	Pharmaceutical Analysis	3	-
22PD33T	Pharmacotherapeutics-II	3	1
22PD33P	Pharmacotherapeutics-II	3	-
22PD34T	Pharmaceutical Jurisprudence	2	-
22PD35T	Medicinal Chemistry	3	1
22PD35P	Medicinal Chemistry	3	-
22PD36T	Pharmaceutical Formulations	2	1
22PD36P	Pharmaceutical Formulations	3	-
	Total hours	**31**	**5**
	Grand Total		**36**

Fourth Year:

Subject Code	Name of Subject	No. of hours/ Week	No. of hours of Tutorial
22PD41T	Pharmacotherapeutics-III	3	1
22PD41P	Pharmacotherapeutics-III	3	-
22PD42T	Hospital Pharmacy	2	1
22PD42P	Hospital Pharmacy	3	-
22PD43T	Clinical Pharmacy	3	1
22PD43P	Clinical Pharmacy	3	-
22PD44T	Biostatistics & Research Methodology	2	1
22PD45T	Biopharmaceutics & Pharmacokinetics	3	1
22PD45P	Biopharmaceutics & Pharmacokinetics	3	-
22PD46T	Clinical Toxicology	2	1
	Total hours	**27**	**6**
	Grand Total		**33**

Fifth Year:

Subject Code	Name of Subject	No. of hours/ Week	No. of hours of Tutorial
22PD51T	Clinical Research	3	1
22PD52T	Pharmacoepidemiology and Pharmacoeconomics	3	1
22PD53T	Clinical Pharmacokinetics & Pharmacotherapeutic Drug Monitoring	2	1
22PD54	Clerkship *	-	1
22PD55P	Project work (Six Months)	20	-
	Total hours	**28**	**4**
	Grand Total		**32**

***** Attending ward rounds on daily basis.

Sixth Year:

Internship or residency training including postings in specialty units. Studentshould independently provide the clinical pharmacy services to the allotted wards.

(i) Six months in General Medicine department, and

(ii) Two months each in three other specialty departments

13.2 Pharm.D. (Post Baccalaureate)

Subjects of study and examination scheme for Pharm.D. (Post Baccalaureate)course are given in Tables.

First Year:

Subject Code	Name of Subject	No. of hours/ week	No. of hours of Tutorial
22PD41T	Pharmacotherapeutics-III	3	1
22PD41P	Pharmacotherapeutics-III	3	-
22PD42T	Hospital Pharmacy	2	1
22PD42P	Hospital Pharmacy	3	-
22PD43T	Clinical Pharmacy	3	1
22PD43P	Clinical Pharmacy	3	-

22PD44T	Biostatistics & Research Methodology	2	1
22PD45T	Biopharmaceutics & Pharmacokinetics	3	1
22PD45P	Biopharmaceutics & Pharmacokinetics	3	-
22PD46T	Clinical Toxicology	2	1
22PD47T	Pharmacotherapeutics I & II	3	1
22PD47P	Pharmacotherapeutics I & II	3	-
	Total hours	**33**	**7**
	Grand Total		**40**

Second Year:

Subject Code	Name of Subject	No. of hours/ Week	No. of hours of Tutorial
22PD51T	Clinical Research	3	1
22PD52T	Pharmacoepidemiology and Pharmacoeconomics	3	1
22PD53T	Clinical Pharmacokinetics & Pharmacotherapeutic Drug Monitoring	2	1
22PD54	Clerkship *	-	1
22PD55P	Project work (Six Months)	20	-
	Total hours	**28**	**4**
	Grand Total		**32**

***** Attending ward rounds on daily basis.

Third Year:

Internship or residency training including postings in specialty units. Studentshould independently provide the clinical pharmacy services to the allotted wards.

(i) Six months in General Medicine department, and

(ii) Two months each in three other specialty departments

14. Attendance:

14.1. A candidate pursuing Pharm.D. course shall study in the concerned department of the Institution for the entire period as a full-time candidate. No candidate is permitted to work in any outside laboratory / institution / industry / pharmacy, etc., during the period of study. No

candidate shall join any other course of study or appear for any other degree examination conducted by this university or any other university in India or abroad during the period of registration.

14.2. Each year shall be taken as a unit for the purpose of calculating attendance.

14.3. A candidate who has put in a minimum of 80% of attendance in the theory and practical assignments separately and who has fulfilled all other requirements of the course shall be permitted to appear for the University examination.

15. Examinations

1. Every year there shall be an annual examination and a supplementaryexamination to examine the students.
2. The examinations shall be of written and practical (including oral nature) carrying maximum marks for each part of a subject as indicated in Tables below:

15.1. Scheme of Examination

TABLES

Pharm.D.

First Year examination:

Subject Code	Subject	Duration (University exam - hrs)	Maximum Marks		Total
			Sessional Exam	University exam	
22PD11T	Human Anatomy and Physiology	03	30	70	100
22PD11P	Human Anatomy andPhysiology	04	30	70	100
22PD12T	Pharmaceutics	03	30	70	100
22PD12P	Pharmaceutics	04	30	70	100
22PD13T	Medicinal Biochemistry	03	30	70	100
22PD13P	Medicinal Biochemistry	04	30	70	100
22PD14T	Pharmaceutical Organic Chemistry	03	30	70	100

22PD14P	Pharmaceutical Organic Chemistry		04	30	70	100
22PD15T	Pharmaceutical Inorganic Chemistry		03	30	70	100
22PD15P	Pharmaceutical Inorganic Chemistry		04	30	70	100
22PD16T*	Remedial Mathematics^{+}/ Biology^{++}		03	-	100*	100*
22PD16P*	Remedial Biology^{++}		04	-	100*	100*
22PD17T*	Constitution of India		03	-	100*	100*
	TOTAL	**Theory**	**500**		**Grand**	**1000**
		Practical	**500**		**Total**	

+ For mathematics deficient students ++ For Biology deficient students
*College examination only

Second Year examination:

Subject Code	**Subject**		**Duration (University exam - hrs)**	**Maximum Marks**		**Total**
				Sessional Exam	**University exam**	
22PD21T	Pathophysiology		03	30	70	100
22PD22T	Pharmaceutical Microbiology		03	30	70	100
22PD22P	Pharmaceutical Microbiology		04	30	70	100
22PD23T	Pharmacognosy & Phytopharmaceuticals		03	30	70	100
22PD23P	Pharmacognosy & Phytopharmaceuticals		04	30	70	100
22PD24T	Pharmacology-I		03	30	70	100
22PD25T	Community Pharmacy		03	30	70	100
22PD26T	Pharmacotherapeutics-I		03	30	70	100
22PD26P	Pharmacotherapeutics-I		04	30	70	100
22PD27T*	Human Rights, Gender Equity and Environmental Studies		03	-	100*	100 *
	TOTAL	**Theory**	**600**		**Grand**	**900**
		Practical	**300**		**Total**	

Total: Theory 600 Practical 300 Grand Total 900
*College examination only

Third Year examination:

Subject Code	Subject		Duration (University exam - hrs)	Maximum Marks		Total
				Sessional Exam	University exam	
22PD31T	Pharmacology-II		03	30	70	100
22PD31P	Pharmacology-II		04	30	70	100
22PD32T	Pharmaceutical Analysis		03	30	70	100
22PD32P	Pharmaceutical Analysis		04	30	70	100
22PD33T	Pharmacotherapeutics-II		03	30	70	100
22PD33P	Pharmacotherapeutics-II		04	30	70	100
22PD34T	Pharmaceutical Jurisprudence		03	30	70	100
22PD35T	Medicinal Chemistry		03	30	70	100
22PD35P	Medicinal Chemistry		04	30	70	100
22PD36T	Pharmaceutical Formulations		03	30	70	100
22PD36P	Pharmaceutical Formulations		04	30	70	100
	TOTAL	**Theory** **Practical**	**600** **500**		**Grand Total**	**1100**

Fourth Year examination:

Subject Code	Subject		Duration (University exam - hrs)	Maximum Marks		Total
				Sessional Exam	University exam	
22PD41T	Pharmacotherapeutics-III		03	30	70	100
22PD41P	Pharmacotherapeutics-III		04	30	70	100
22PD42T	Hospital Pharmacy		03	30	70	100
22PD42P	Hospital Pharmacy		04	30	70	100
22PD43T	Clinical Pharmacy		03	30	70	100
22PD43P	Clinical Pharmacy		04	30	70	100
22PD44T	Biostatistics & ResearchMethodology		03	30	70	100
22PD45T	Biopharmaceutics & Pharmacokinetics		03	30	70	100
22PD45P	Biopharmaceutics & Pharmacokinetics		04	30	70	100
22PD46T	Clinical Toxicology		03	30	70	100
	TOTAL	**Theory** **Practical**	**600** **400**		**Grand Total**	**1000**

Fifth Year examination:

Subject Code	Subject		Duration (University exam - hrs)	Maximum Marks		Total
				Sessional Exam	University exam	
22PD51T	Clinical Research		03	30	70	100
22PD52T	Pharmacoepidemiology and Pharmacoeconomics		03	30	70	100
22PD53T	Clinical Pharmacokinetics & Pharmacotherapeutic Drug Monitoring		03	30	70	100
22PD54	Clerkship *		03	30	70	100
22PD55P	Project work (Six Months)		04	-	100**	100
	TOTAL	**Theory** **Practical**	**300** **200**		**Grand Total**	**500**

***** Attending ward rounds on daily basis.

****** 30 marks – viva-voce (oral) 70 marks – Thesis work

Pharm.D. (Post Baccalaureate)First Year examination:

Subject Code	Subject	Duration (University exam - hrs)	Maximum Marks		Total
			Sessional Exam	University exam	
22PD41T	Pharmacotherapeutics-III	03	30	70	100
22PD41P	Pharmacotherapeutics-III	04	30	70	100
22PD42T	Hospital Pharmacy	03	30	70	100
22PD42P	Hospital Pharmacy	04	30	70	100
22PD43T	Clinical Pharmacy	03	30	70	100
22PD43P	Clinical Pharmacy	04	30	70	100
22PD44T	Biostatistics & Research Methodology	03	30	70	100
22PD45T	Biopharmaceutics & Pharmacokinetics	03	30	70	100
22PD45P	Biopharmaceutics & Pharmacokinetics	04	30	70	100
22PD46T	Clinical Toxicology	03	30	70	100

22PD47T	Pharmacotherapeutics I I & II		03	30	70	100
22PD47P	Pharmacotherapeutics I & II		04	30	70	100
	TOTAL	**Theory** **Practical**	**700** **500**		**Grand Total**	**1200**

Second Year examination:

Subject Code	**Subject**		**Duration (University exam - hrs)**	**Maximum Marks**		**Total**
				Sessional Exam	**University exam**	
22PD51T	Clinical Research		03	30	70	100
22PD52T	Pharmacoepidemiology and Pharmacoeconomics		03	30	70	100
22PD53T	Clinical Pharmacokinetics& Pharmacotherapeutic Drug Monitoring		03	30	70	100
22PD54	Clerkship *		03	30	70	100
22PD55P	Project work (Six Months)		04	-	100**	100
	TOTAL	**Theory** **Practical**	**300** **200**		**Grand Total**	**500**

Total: Theory 300 Practical 200 Grand Total 500

***** Attending ward rounds on daily basis.

****** 30 marks – viva-voce (oral) 70 marks – Thesis work

15.2. Evaluation

Evaluation is based on formative evaluation (internal assessment) and summative evaluation (University examination).

15.2.1. **Internal Assessment** (Formative Evaluation)

1. A regular record of both theory and practical class work and examinations conducted in the institution imparting training for Pharm.D. Or Pharm.D. (Post Baccalaureate) courses, shall be maintained for each student in the institution and 30 marks for each theory and 30 marks for each practical subject shall be allotted as sessional.
2. There shall be at least three periodic sessional examinations during each academic year and the highest aggregate of any two performances shall form the basis ofcalculating sessional marks.

3. The sessional marks in practicals shall be allotted on thefollowing basis:
   i. Performance in the sessional examination 20 marks
   ii. Day to day assessment in the practical class 10 markswork, records, promptness, viva-voce record maintenance, etc

15.2.2. University examinations (Summative Evaluation):

1. Theory examination shall be of three hours and practical examination shall be of four hours duration.
2. Theory and practical of a particular subject are considered as individual subjects for the purpose of pass criteria.
3. Those candidates who fail in one or more subjects shall have to appear only in the subject so failed, in the subsequent examinations.
4. Practical examination shall also consist of a viva – voce (Oral) examination.
5. Clerkship examination - Oral examination shall be conducted after the completion of clerkship of students. An external and an internal examiner will evaluate the student. Students may be asked to present the allotted medical cases followed by discussion. Students' capabilities in delivering clinical pharmacy services, pharmaceutical care planning and knowledge of therapeutics shall be assessed.

15.3 Criteria for Pass:

a. Candidate shall be declared as pass if he secures 50% of marks (including internal assessment) in each subject in theory and practical examination separately except in the subjects for which examinations are conducted at the college level (by the college) for which the pass marks is 40%.
b. Theory and Practical of a particular subject are considered as individualsubjects for the purpose of pass criteria.
c. Those candidates who fail in one or more subjects shall have to appear only in the subject so failed, in the subsequent examinations i.e., if a candidate fails in theory or in practical of a subject, he has to appear only in theory or in practical as the case may be.

15.4 Carryover benefit:

A candidate of I Pharm.D is permitted to carryover not more than two

subjects of the first year to II Pharm.D and appear for II Pharm.D. However, failure in more than two subjects in any year shall debar him or her from promotion to the next year classes.

Failure in two or more subjects in n^{th} year prevents the promotion to $(n + 2)^{th}$ year, though all subjects of $(n + 1)^{th}$ year are cleared.

15.5 Internship:

(1) Internship is a phase of training wherein a student is expected to conduct actual practice of pharmacy and health care and acquires skills under the supervision so that he or she may become capable of functioning independently.

(2) Every student has to undergo one-year internship as per the regulations of internship.

15.6 Rules for grace marks

The subject Grace of 1% of the maximum of the total marks in the examination subject to a maximum of 5 will be awarded to the failed course(s), provided on award of grace marks the candidate passes in thatsubject/examination. Award of grace marks shall not be applicable for compartmental examinations.

Subject grace awarded to a subject as per above shall be deducted from a subject which has the highest secured marks and on deduction the candidate should not fail in that subject. Secondly, if any one subject is not having marks more than the grace marks to be awarded than the minimum for passing, then the grace marks shall be awarded by deducting from two or more subjects such that total marks before gracing and after gracing shall remain the same. If there is no scope for deducting marks from other passed subjects to award marks for the failed subjects, grace marks shall not be awarded.

There shall be no provision to award grace marks for improvement of class.

15.7 Re-totaling

Re-totaling of marks is permitted for theory papers only. The university, on application within the stipulated time and remittance of a prescribed fee, shall permit a recounting of marks, for the subject(s) applied. The marks obtained after re-totaling shall be the final marks awarded.

15.8 Supplementary Examination:

Supplementary examination shall be conducted by the university for the benefit of unsuccessful candidates. Supplementary examinations will be

conducted within six weeks/six months from the date of announcement of results.

- A candidate detained for lack of attendance, internal assessment marks will be barred from appearing in any one or all course/s for thesupplementary examination.
- A candidate dropping from appearance in any or all subjects /courses at regular examination is disallowed from taking dropped subject(s)/course(s) at the supplementary examinations.
- If a candidate submits application for appearing for the examination but does not appear for any of the subjects in the university examination, he can appear for supplementary examination provided other conditions such as attendance requirement, internal assessmentmarks, etc. are fulfilled.
- A candidate who is promoted to the next higher class as per carry over regulations (except where apex bodies do not permit), if he clears the lower year/semester/phase examinations in the main examination is allowed to appear for the higher class examination during supplementary examinations provided other conditions such as attendance requirement, internal assessment marks, etc. are fulfilled.

A candidate permitted to appear for the supplementary examination can improvehis internal assessment marks before he takes the supplementary examination by subjecting himself to internal assessment procedure as practiced in the college.

16. Practical Training

16.1 **Hospital posting** –

a) Every student shall be posted in constituent hospital for a periodof not less than fifty hours to be covered in not less than 200 working days in each of second, third & fourth year of Pharm. D Programme. Each student shall submit report duly certified by the preceptor and duly attested by the Head of the Department or Institution as prescribed. In the fifth year, every student shall spend half a day in the morning hours attending ward rounds on daily basis as a part of clerkship. Theory teaching shall be scheduled in the afternoon.

b) Every student shall be posted in constituent hospital for a periodof not less than 200 working days in the first year of Pharm.D (PB) programme. each student shall submit report duly certifiedby the preceptor and duly attested by the Head of the Department

or Institution as prescribed. In the second year, every student shall spend half a day in the morning hours attending ward rounds on daily basis as a part of clerkship. Theory teaching shallbe scheduled in the afternoon.

16.2 **Project work** - (1) To allow the student to develop data collection and reporting skills in the area of community, hospital and clinical pharmacy, a project work shall be carried out in fifth year / second year of Pharm.D and Pharm.D (Post Baccalaureate) respectively under the supervision of a teacher. The project topic must be approved by the Head of the Department or Head of the Institution. The same shall be announced to students within one month of commencement of the fifth year classes. Project work shall be presented in a written report and as a seminar at the end of the year. External and the internal examiners shall do the assessment of the project work.

(2) Project work shall comprise of objectives of the work, methodology, results, discussions and conclusions.

16.3 Objectives of project work - The main objectives of the project work isto

(i) show the evidence of having made accurate description of published work of others and of having recorded the findings in an impartial manner; and

(ii) develop the students in data collection, analysis and reporting and interpretation skills.

16.4 **Methodology** - To complete the project work following methodology shall be adopted, namely:-

(i) Students shall work in groups of not less than *two* but not more than *four* under an authorized teacher;

(ii) project topic shall be approved by the Head of the Department or Head of the Institution;

(iii) project work chosen shall be related to the pharmacy practice in community, hospital and clinical setup. It shall be patient and treatment (Medicine) oriented, like drug utilization reviews, pharmacoepidemiology, pharmacovigilance or pharmacoeconomics;

(iv) project work shall be approved by the institutional ethics committee

(v) student shall present at least three seminars, one in the

beginning, one at middle and one at the end of the project work; and

(vi) a write-up (synopsis) of the project indicating title, objectives, methodology anticipated benefits and references shall be submitted to the Head of the Department or Head of the Institution before the commencement of the fifth and second year Pharm.D and Pharm.D (Post Baccalaureate) classes respectively.

16.5 **Reporting**:

(1) Student working on the project shall submit jointly to the Head of the Department or Head of the Institution a project report of about 40 -50 pages. Project report should include a certificate issued by the authorized teacher, Head of the Department as well as by the Head of the Institution

(2) Project report shall be computer typed in double space using Times Roman font on A4 paper. The title shall be in bold with font size 18, sub-tiles in bold with font size 14 and the text with font size 12. The cover page of the project report shall contain details about the name of the student and the name of the authorized teacher with font size 14.

(3) Submission of the project report shall be done at least one month prior to the commencement of annual or supplementary examination.

16.6 **Evaluation:** The following methodology shall be adopted for evaluating the project work -

i. Project work shall be evaluated by internal and external examiners.

ii. Students shall be evaluated in groups for four hours (i.e., about half an hour for a group of four students).

iii. Three seminars presented by students shall be evaluated for thirty marks each and the average of best two shall be forwarded to the university with marks of other subjects.

iv. Evaluation shall be done on the following items: **Marks**

a) Write up of the seminar	(7.5)
b) Presentation of work	(7.5)
c) Communication skills	(7.5)
d) Question and answer skills	(7.5)
	Total (30 marks)

v Final evaluation of project work shall be done on the following items:

	Marks
a) Write up of the project work	(25.0)
b) Presentation of work	(15.0)
c) Communication skills	(15.0)
d) Question and answer skills	(15.0)
Total	(70 marks)

Explanation - For the purposes of differentiation in the evaluation in case of topic being the same for the group of students, the same shall be done based on item numbers b, c and d mentioned above.

17. Declaration of class:

Class will be awarded only to those candidates who pass the examination in the first attempt.

17.1 Class shall be declared at the end of every year and will be on the basis of the aggregate of marks scored in that year.
75% and above – First class with Distinction
60% and above and less that 75% - First
Class 50% and above and less that 60% -
Second Class
Candidates who pass the examinations in more than one attempt shall be declared to have passed in 'Pass' class irrespective of the percentage of marks secured.

17.2 An attempt means the appearance of a candidate for one or more courses either in part or full in a particular examination.

17.3 A candidate who fails in main examination and passes one or more subjects or all subjects in the supplementary examination is not eligible for award of class or distinction. Passing in supplementary examination by such candidates shall be considered as attempt.

17.4 If a candidate submits application for appearing for the regular examination but does not appear for any of the courses/subjects in the regular University examination, he can appear for supplementary examination provided other conditions such as attendance requirement, internal assessment marks, etc. are fulfilled and his appearing in the supplementary examination shall be considered as the first attempt.

17.5 Candidates who pass the subjects in the supplementary examinations are not eligible for the award of Gold Medal or Merit Certificate.

18. Award of Merit Certificate / Ranks

Merit certificate shall be awarded on the basis of aggregate marks of all the years of examination as per the duration of the course. In case lateral entry candidates are admitted, Merit Certificate shall be awarded on the basis of aggregate marks of the common years of study for both regular and lateral entrystudents.

Further Only those candidates who have completed the course and fulfilled all the requirements in the minimum number of years prescribed and who have passed each year in the first attempt are eligible for the award of ranks.

PROGRAM OUTCOMES

At the end of the program, graduates will be able to...

PO1: Explain the chemistry and synthesis of medicinal compounds PO2: Describe important organic reactions with mechanisms

PO3: Describe the metabolic process of bio molecules in health and illness(metabolic disorders)

PO4: Able to formulate, store and analyse various pharmaceutical dosageforms including herbal medicines in commercial production and research

PO5: Discuss the source, active constituents and uses of crude drugs

PO6: Develop patient care in the creation of individualized/assess, drug therapy management.

PO7: Manage and document patient care activities efficiently.

PO8: Analyze and apply legal and regulatory principles directing drug development. and approval and medication distribution, use and management systems.

PO9: Identify methods for evaluating cost-effectiveness, cost-minimisation and cost-benefit of medication use.

PO10: Demonstrate personal/professional development, through ongoing self- directed learning and self-refection.

PO11: Develop and maintain a collaborative and constructive pharmacist- patient relationship.

PO12: Apply evidence-based practice, including knowledge of study design and statistics, to the care of individual patients and populations.

PO13: Promote health improvement, wellness, and disease prevention.

PO14: Provide preventive and primitive health care services to the community. PO15: Exhibit knowledge of and confidence with the pharmacist's role in health care systems (eg. hospital, ambulatory care/community practice settings) and the provision of longitudinal car

22PD11T: HUMAN ANATOMY & PHYSIOLOGY (THEORY)

Theory: 3 Hrs. /Week **75 Hours**

Course Outcome

At the end of the course students will be able to...

CO No.	Outcome statement
CO1	Explain the anatomy, physiology and functions of various Tissues and cell, organization of cellular system. .
CO2	Classify different types of tissue and explain anatomy and physiology of skeletal system and joints
CO3	Explain Haemopoetic and lymphatic system homeostatic and its altered physiology
CO4	Explain the anatomy and Physiology of cardiovascular and respiratory system and its disorders
CO5	Explain the anatomy and Physiology of digestive ,nervous, urinary and reproductive system and its disorders
CO6	Explain the Anatomy and Physiology of endocrine system and sense organs and its disorders
CO7	Describe the Physiology of muscle contraction and its disorders
CO8	Explain sport physiology , drugs and athletics

1. **Scope and Objectives:** This course is designed to impart a fundamental knowledge on the structure and functions of the human body. It also helps inunderstanding both homeostasis mechanisms and homeostatic imbalances of various body systems. Since a medicament, which is produced by pharmacist, is used to correct the deviations in human body, it enhances the understandingof how the drugs act on the various body systems in correcting the disease state of the organs.

   Upon completion of the course the student shall be able to:

   1. describe the structure (gross and histology) and functions of variousorgans of the human body;
   2. describe the various homeostatic mechanisms and their imbalancesof various systems;
   3. identify the various tissues and organs of the different systems of thehuman body;

4. perform the hematological tests and also record blood pressure, heartrate, pulse and respiratory volumes;
5. appreciate coordinated working pattern of different organs of eachsystem; and
6. appreciate the interlinked mechanisms in the maintenance of normalfunctioning (homeostasis) of human body

2. Course materials:

Text books

a) Gerard J. Tortora and Bryan Derrickson. Principles of anatomy and physiology, 14th ed.2013, HarperCollins College New York.
b) Anne Waught & Allison Grant. Ross and Wilson's foundations of Anatomy and Physiology in Health and illness. 12th ed. 2014, Churchill Livingstone, Edinburg.

Reference books

a) Guyton Arthur, C. *Physiology of human body*. 12thed. 2010, Holtsaunders.
b) Chatterjee, C.C. *Human physiology*. Volume I & II. 11th ed. 2016, medicalallied agency, Calcutta.
c) Peter L. Williams, Roger Warwick, Mary Dyson and Lawrence, H. *Gray'sanatomy.* 37th ed. Churchill Livingstone, London.
d) K. Sembulingam & Prema Sembulingam, Medical Physiology, 6thed.2014, Jaypee Brothers. Newdelhi.

3. Lecture wise program:

	Topics	**Hrs**
1.	Scope of anatomy and physiology, basic terminologies used in this subject (Description of the body as such planes and terminologies)	02
2	General Physiology: Structure of cell – its components and their functions. Homeostasis, Mechanism of transport across cell membrane, Secondary messengers, Ion channels	04
3	Elementary tissues of the human body: epithelial, connective, muscular and nervous tissues-their sub-types and characteristics	04

4	a) Osseous system - structure, composition and functions of the skeleton.(done in practical classes - 6hrs) b) Classification of joints, types of movements of joints anddisorders of joints (Definitions only)	01
5	Haemopoetic system a) Composition and functions of blood b) Haemopoesis and disorders of blood components (Definition only) c) Blood groups d) Clotting factors and mechanism e) Platelets and disorders of coagulation	05
6	Lymph a) Lymph and lymphatic system, composition, formationand circulation. b) Spleen: structure and functions, disorders c) Disorders of lymphatic system (Definition only)	04
7	Cardiovascular system a) Anatomy and functions of heart b) Blood vessels and circulation(Pulmonary, coronary and systemic circulation) c) Electrocardiogram (ECG) d) Cardiac cycle and heart sounds e) Blood pressure – its maintenance and regulation f) Definition of the following disorders Hypertension, hypotension, arteriosclerosis, atherosclerosis, angina, myocardial infarction, congestiveheart failure, cardiac arrhythmias	06
8	Respiratory system a) Anatomy of respiratory organs and functions b) Mechanism / physiology of respiration and regulation of respiration c) Transport of respiratory gases d) Respiratory volumes and capacities, and definition of: hypoxia, asphyxia, oxygen therapy and resuscitation	05
9	Digestive system a) Anatomy and physiology of GIT b) Anatomy and functions of accessory glands of GIT	06

c) Digestion and absorption
d) Disorders of GIT (Definitions only)

10 Nervous system 08

a) Definition and classification of nervous system.
b) Synapse and neurotransmitter, ménages, ventricles of the brain and CSF
c) Anatomy, physiology and functional areas of cerebrum
d) Anatomy and physiology of cerebellum
e) Anatomy and physiology of mid brain
f) Thalamus, hypothalamus and basal ganglia
g) Spinal card: Structure & reflexes – mono-poly-planter
h) Cranial nerves – names and functions
i) ANS – Anatomy & functions of sympathetic & parasympathetic N.S.

11 Urinary system 05

a) Anatomy and physiology of urinary system
b) Formation of urine
c) Renin angiotensin aldosterone system – Juxtaglomerular apparatus – acid base balance
d) Clearance tests and micturition

12 Endocrine system 06

a) Pituitary gland
b) Adrenal gland
c) Thyroid and Parathyroid glands
d) Pancreas and gonads

13 Reproductive system 07

a) Male and female reproductive system organs anatomy and physiology.
b) Their hormones – physiology of menstruation
c) Spermatogenesis & Oogenesis
d) Sex determination (genetic basis)
e) Pregnancy & maintenance. Parturition
f) Contraceptive devices

14 Sense organs 06

a) Eye
b) Ear
c) Skin
d) Tongue & Nose

15 Skeletal muscles 03

a) Histology
b) Physiology of Muscle contraction
c) Physiological properties of skeletal muscle and their disorders (Definitions only)

16 Sports physiology 03

a) Muscles in exercise, Effect of athletic training onmuscles and muscle performance,
b) Respiration in exercise, CVS in exercise, body heat inexercise, body fluids and salts in exercise,
c) Drugs and athletics

22PD11P: HUMAN ANATOMY & PHYSIOLOGY (PRACTICAL)

Practical: 3 Hrs/Week **75 Hours**

General Requirements: Laboratory napkin, muslin cloth, record, observationbook (100 pages), stationery items, and blood lancet.

Course materials: Textbooks

Goyal, R. K, Natvar M.P, and Shah S.A, Practical anatomy, physiology andbiochemistry, 2011 B.S Shah Prakashan, Ahmedabad.

Reference books

1. Ranade VG, Textbook of practical physiology, 4rd edition, PVG, Pune
2. Anderson Experimental Physiology, Latest edition, Publisher: NA

List of Experiments:

1. Study of a compound microscope.
2. Study of tissues of the human body
   a) Epithelial tissue.
   b) Muscular tissue.
3. Study of tissues of the human body
   a) Connective tissue.
   b) Nervous tissue.
4. Study of appliances used in hematological experiments.
5. Determination of total WBC count of blood.**
6. Determination of total RBC count of blood.**
7. Determination of differential leukocyte count of blood.*
8. Determination of
   a) Erythrocyte Sedimentation Rate. (ESR)*
   b) Hemoglobin content of blood.*
   c) Bleeding time & clotting time.*
9. Determination of
   a) Blood pressure.
   b) Blood group.*

10. Study of various systems with the help of charts, models & specimens
    a) Skeleton system part I-axial skeleton.
    b) Skeleton system part II- appendicular skeleton.
    c) Cardiovascular system.
    d) Respiratory system.
    e) Digestive system.
    f) Urinary system.
    g) Nervous system.
    h) Special Senses.
    i) Reproductive system.
11. Study of different family planning appliances.
12. Study of pregnancy diagnosis test.
13. Study of appliances used in experimental physiology.
14. Study of record of simple muscle curve using gastroenemius sciatic nervepreparation.
15. Study of simple summation curve using gastroenemius sciatic nervepreparation.
16. Study of simple effect of temperature using gastroenemius sciatic nervepreparation.
17. Study of simple effect of load & after load using gastroenemiussciatic nerve preparation.
18. Study of fatigue curve using gastroenemius sciatic nerve preparation.

Scheme of Practical Examination:

	Sessionals	**Annual**
Identification	04	10
Synopsis	04	10
Major Experiment**	07	20
Minor Experiment*	03	15
Viva	02	15
Max Marks	**20**	**70**
Duration	**03 hrs**	**04 hrs**

Note: Total sessional marks is 30 (20 for practical sessional plus 10 marks for regularity,promptness, viva-voce and record maintenance).

22PD12T: PHARMACEUTICS (THEORY)

Theory: 2 Hrs. /Week **50 Hours**

Course Outcome

At the end of the course students will be able to...

CO No.	Outcome statement
CO1	Learn handling of prescription, posology & dose calculation of drug in children. Different types of dosage form
CO2	Discuss history of the profession of Pharmacy in India & Pharmacopeia and its development.
CO3	Explain the different pharmaceutical calculation involved in formulation
CO4	Elaborate basic requirement and formulation of powder and liquid (monophasic & biphasic) dosages form
CO5	Understand basic requirement, formulation and evaluation of suppositories and pessaries
CO6	Explain different types of extraction process mainly maceration & percolation and their application.
CO7	Explain the different types of surgical aids and their application
CO8	Learn type of Pharmaceutical incompatibility

1. **Scope and objectives:** This course is designed to impart a fundamental knowledge on the art and science of formulating different dosage forms. It prepares the students for most basics of the applied field of pharmacy.
   Upon the completion of the course the student should be able to:
   1. know the formulation aspects of different dosage forms;
   2. do different pharmaceutical calculation involved in formulation;
   3. formulate different types of dosage forms; and
   4. Appreciate the importance of good formulation for effectiveness.

2. **Course materials:**
   Text books
   a) Carter S.J, Cooper and Gunn's Dispensing for Pharmaceutical Students.12ed. 2008, CBS Publishers & Distributors Pvt. Ltd

b) N.K.Jain and S.N.Sharma, A textbook Professional Pharmacy, 6th ed. 2016,Vallabha Prakashan, New Delhi.

Reference books

a) Introduction to Pharmaceutical dosage forms by Howard C. Ansel.3rd.ed,1981

b) Remington's Pharmaceutical Sciences. Vol 1-3, 22th ed. 2010

c) Register of General Pharmacy by Cooper and Gunn. Popular Prakashan

d) General Pharmacy by M.L.Schroff. Five Stars Enterprises

3. Lecture wise programme:

	Topics	Hrs
1	a) Introduction to dosage forms - classification and definitions b) Prescription: definition, parts and handling c) Posology: Definition, Factors affecting dose selection. Calculation of children and infant doses.	06
2	History of profession of Pharmacy in India in relation to pharmacy education, industry and organizationin brief.	03
3	Development of Indian Pharmacopoeia. Salient features of latest edition of IP (IP 2008) and introduction to other Pharmacopoeias such as BP, USP, European Pharmacopoeia, Extra pharmacopoeia and Indian National formulary.	03
4	Weights and measures, Calculations involving percentage solutions, allegation, proof spirit, isotonic solutions.	06
5	Powders and Granules: Classification advantages and disadvantages, Preparation of simple, compound powders, Insufflations, Dusting powders, Eutectic and Explosive powders, Tooth powder and effervescent powders and granules.	05
6	Monophasic Dosage forms: Theoretical aspects of formulation including adjuvant like Vehicles, Organoleptic additives and Stabilizers, with examples. Study of Monophasic liquids (formulation aspects and examples) like gargles, mouthwashes, Throat paint, Ear	06

	drops, Nasal drops, Liniments and lotions, Enemas andcollodions.	
7	Biphasic dosage forms: Suspensions and emulsions, Definition, advantages and disadvantages, classification and formulation of Suspensions and Emulsions. Test for the type of emulsion and stability problems in emulsions.	06
8	Suppositories: Definition, advantages and disadvantages, types of base, a method of preparation, Displacement value and evaluation.	03
9	Galenicals: Definition, different extraction processes like infusion, Decoction, Maceration and Percolation. Study ofMaceration and Percolation processes	06
10	Surgical aids: Surgical dressings, sutures, ligatures and preparation of surgical catgut.	04
11	Incompatibilities: Introduction, classification, Examples, and methods to overcome Physical and therapeuticincompatibilities	02

22PD12P: PHARMACEUTICS (PRACTICAL)

Practical: 3 Hrs. /Week **75 Hours**

List of Experiments:

1. **Syrups**
   a) Simple Syrup I.P
   b) Syrup of Ephedrine Hydrochloride NF
   c) Orange Syrup
2. **Elixir**
   a) Piperizine citrate elixir BP
   b) Paracetamol elixir BPC
3. **Linctus**
   a) Simple linctus BPC
   b) Pediatric simple linctus BPC
4. **Solutions**
   a) Solution of cresol with soap IP
   b) Aqueous Iodine Solution IP
   c) Strong solution of Iodine IP
   d) Strong solution of ammonium acetate IP
5. **Liniments**
   a) Liniment of turpentine IP*
   b) Liniment of camphor IP
6. **Suspensions***
   a) Calamine lotion
   b) Magnesium Hydroxide mixture BP
7. **Emulsions***
   a) Cod liver oil emulsion
   b) Liquid paraffin emulsion
8. **Powders***
   a) Eutectic powder
   b) Dusting powder
   c) Insufflations
9. **Suppositories***
   a) Boric acid suppositories
   b) Chloral suppositories

10. Incompatibilities

a) Preparations having with Physical Incompatibilities (3 Nos)

***** Colorless bottles required for dispensing Paper envelope (white), butter paperand white paper required for dispensing.

Scheme of Practical Examination:

	Sessionals	**Annual**
Synopsis	05	15
Major Experiment	10	25
Minor Experiment	03	15
Viva	02	15
Max Marks	**20**	**70**
Duration	**03 hrs**	**04 hrs**

Note: Total sessional marks is 30 (20 for practical sessional plus 10 marks for regularity,promptness, viva-voce and record maintenance).

22PD13T: MEDICINAL BIOCHEMISTRY (THEORY)

Theory: 3 Hrs. /Week **75 Hours**

Course Outcome

At the end of the course students will be able to…

CO No.	Outcome statement
CO1	Explain the concept of transport across cell membrane and energy rich compounds
CO2	Describe the properties, classification, kinetics, inhibitors, importance of enzymes in diagnosis of diseases and therapeutic uses
CO3	Describe the metabolism of carbohydrate and Glucose tolerance test
CO4	Describe the metabolism of lipids in physiological and pathological condition
CO5	Explain Electron transport chain, oxidative phosphorylation
CO6	Describe the metabolism of Protein and amino acids in physiological and pathological condition
CO7	Describe genetic organisation of mammalian genome, translation, replication, transcription, mutation metabolism of Nucleotides
CO8	Explain kidney, liver, lipid profile test and immunochemical techniques

1. **Scope and Objectives:** Biochemistry deals with complete understanding of the molecular level of the chemical process associated with living cells in normal and abnormal state. Clinical chemistry deals with the study of chemical aspects of human life in health and illness and the application of chemical laboratory methods to diagnosis, control of treatment and prevention of diseases.
   The objective of the present course is providing biochemical facts and the principles to the students of pharmacy.
   Upon completion of the course student shall be able to –
   1. understand the catalytic activity of enzymes and importance of enzymes in diagnosis of diseases and therapeutic agents;
   2. know the metabolic pathways of biomolecules in health and illness

(metabolic disorders);

3. understand the genetic organization of mammalian genome, protein synthesis, replication, mutation and repair mechanism.
4. know the biochemical principles of organ function tests of kidney, liverand endocrine gland; and
5. do the qualitative analysis and determination of biomolecules in the bodyfluids and their clinical significance.

2. Course Materials: Textbooks (Theory)

a. Harper's Illustrated of biochemistry - Robert K. Murray, Darryl K.Granner, Peter A. Mayes,18th ed., 2003. Lange.
b. Satyanarayana U and Chakrapani U, Biochemistry, 4th ed. 2016, ElsevierIndia PVT. LTD, Newdelhi
c. Text book of clinical chemistry- Alex Kaplan &Laverve L.Szabo, 4th ed.1995, Williams and Wilkins Co.,

Reference books (Theory)

a. Principles of biochemistry – Lehninger, 6th ed, 2014, W.H.Freeman andCo., New York
b. Text book of biochemistry – Ramarao, 2009,L.K and S. Publisher
c. Practical Biochemistry-David T.Plummer.3rd. ed. 2014, Tata McGraw HillEducation Pvt. Ltd.
d. Practical Biochemistry-Pattabhiraman.4th ed. 2015,All India Publisher andDistributers.

3. Lecture wise programme:

	Topics	Hrs
1	**Introduction to biochemistry:** Cell and its biochemical organization, transport process across the cell membranes. Energy rich compounds; ATP, Cyclic AMP and their biological significance.	05
2	**Enzymes**: Definition; Nomenclature; IUB classification; Factor affecting enzyme activity; Enzymeaction; enzyme inhibition. Isoenzymes and their therapeutic and diagnostic applications; Coenzymes and their biochemical role and deficiency diseases.	10
3	**Carbohydrate metabolism**: Glycolysis, citric acid cycle (TCA cycle),HMP shunt, Glycogenolysis, glycogenesis gluconeogenesis. Metabolic disorders of	11

carbohydrate metabolism (diabetes mellitus and glycogen storage diseases); Glucose tolerance test and its significance; hormonal regulation of carbohydrate metabolism.

4 **Lipid metabolism:** Oxidation of saturated fatty acid; Ketogenesis and ketolysis; biosynthesis of fatty acids; metabolism of cholesterol; Hormonal regulation of lipid metabolism. Defective metabolism of lipids (Atheroslerosis, fatty liver,hypercholesterolmiea). 09

5 **Biological oxidation:** Enzymes and Coenzyme system involved in Biological oxidation. Electron transport chain (its mechanism in energy capture, regulation and inhibition); Oxidative phosphorylation and uncouplers of ETC. 04

6 **Protein and amino acid metabolism:** protein turn over; nitrogen balance; general reactions of catabolism of amino acids (Tranamination deamination & decarboxylation). Urea cycle and its metabolic disorders; production of bile pigments; hyperbilirubinemia, porphorias, jaundice. Metabolic disorder of Aminoacids. 08

7 **Nucleic acid metabolism:** Metabolism of purine and pyrimidine nucleotides; Protein synthesis; Genetic code; inhibition of protein synthesis; DNA damage and repair mechanism; DNA replication (semi conservative). 12

8 **The kidney function tests:** Role of kidney; Laboratory tests for normal function includes- 04

a) Urine analysis (macroscopic and physical examination, quantitative and semi quantitative tests.)
b) Test for NPN constituents. (Creatinine /urea clearance, determination of blood/urine creatinine, urea and uric acid)
c) Urine concentration test
d) Urinary tract calculi. (stones)

9 **Liver function tests:** Physiological role of liver, metabolic, storage, excretory, protective, circulatory functions and function in blood coagulation. 04

a) Test for hepatic dysfunction-Bile pigments metabolism.
b) Test for hepatic function test- Serum bilirubin,urine bilirubin, and urine urobilinogen.

c) Dye tests of excretory function.
d) Tests based upon abnormalities of serum proteins.
e) Selected enzyme activity determination tests.

10	**Lipid profile tests:** Lipoproteins, composition, functions. Determination of serum lipids, total cholesterol, HDL cholesterol, LDL cholesterol and triglycerides.	02
11	**Immunochemical techniques** for determination of hormone levels and protein levels in serum for endocrine diseases and infectious diseases. Radio immuno assay (RIA) and Enzyme Linked Immuno Sorbent Assay (ELISA).	03
12	**Electrolytes:** Body water, compartments, water balance, and electrolyte distribution, Determination of sodium, calcium in the body fluids.	03

22PD13P: MEDICINAL BIOCHEMISTRY (PRACTICAL)

Practical: 3 Hrs. /Week **75 Hours**

Title of the Experiment:

1. Qualitative analysis of normal constituents of urine*.
2. Qualitative analysis of abnormal constituents of urine*.
3. Quantitative estimation of urine chlorides by Volhard's method**.
4. Quantitative estimation of urine sugar by benedicts quantitative reagentmethod**
5. Quantitative estimation of urine creatinine by Jaffe's method**.
6. Quantitative estimation of urine calcium by precipitation method**.
7. Quantitative estimation of serum cholesterol**.
8. Preparation of Folin Wu filtrate from blood*.
9. Quantitative estimation of blood creatinine**.
10. Quantitative estimation of blood sugar Folin-Wu tube method**.
11. Estimation of SGOT in serum**.
12. Estimation of SGPT in serum**.
13. Estimation of Urea in Serum**.
14. Estimation of Proteins in Serum**.
15. Determination of serum bilirubin**
16. Determination of Glucose by means of Glucoseoxidase**.
17. Enzymatic hydrolysis of Glycogen/Starch by Amylases**.
18. Study of factors affecting Enzyme activity**. (pH & Temp.)
19. Preparation of standard buffer solutions and its pH measurements (any two)*

Scheme of Practical Examination:

	Sessionals	**Annual**
Synopsis	05	15
Major Experiment**	10	25
Minor Experiment*	03	15
Viva	02	15
Max Marks	**20**	**70**
Duration	**03 hrs**	**04 hrs**

Note: Total sessional marks is 30 (20 for practical sessional plus 10 marks for regularity,promptness, viva-voce and record maintenance).

22PD14T: PHARMACEUTICAL ORGANIC CHEMISTRY (THEORY)

Theory: 3 Hrs. /Week **75 Hours**

Course Outcome

At the end of the course students will be able to...

CO No.	Outcome statement
CO1	Learn IUPAC/Common system of nomenclature of simple organic compounds belonging to different classes of organic compounds
CO2	Explain physical properties of organic compounds
CO3	Understand free radical/ nucleophillic [alkyl/acyl/aryl] /electrophillic substitution orientation of the reaction, order of reactivity, stability of compounds
CO4	Learn free radical/ nucleophillic / electrophillic addition orientation of the reaction, order of reactivity, stability of compounds
CO5	Learn free radical/ nucleophillic / electrophillic elimination orientation of the reaction, order of reactivity, stability of compounds
CO6	Describe oxidation and reduction reactions
CO7	Explain some named organic reactions with mechanisms
CO8	Discuss the methods of preparation test for purity, principle involved in the assay, important medicinal uses of some important organic compounds.

1. **Scope and objectives**: This course is designed to impart a very good knowledge about
   a) IUPAC/Common system of nomenclature of simple organic compounds belonging to different classes of organic compounds;
   b) Some important physical properties of organic compounds;
   c) Free radical/ nucleophyllic [alkyl/ acyl/ aryl] /electrophyllic substitution free radical/ nucleophyllic / electrophyllic addition, elimination, oxidation and reduction reactions with mechanism, orientation of the reaction, order of reactivity, stability of compounds;
   d) Some named organic reactions with mechanisms; and
   e) Methods of preparation, test for purity, principle involved in the assay,

important medicinal uses of some important organic compounds.

2. Course materials:

Text books

a. T.R. Morrison and R. Boyd - Organic chemistry,7th ed., 2012, PearsonPrentice Hall, Noida

b. Bentley and Driver-Text book of Pharmaceutical chemistry, 8th ed. 2007, Oxford University Press, New York

c. I.L.Finer- Organic chemistry, the fundamentals of chemistry, 6th ed. 2014,Pearson

Reference books

a. Organic chemistry – J.M.Cram and D.J.Cram

b. Organic chemistry- Brown, 8th ed. 2018, John wiley and sons Inc.

c. Advanced organic chemistry- Jerry March, Wiley, 7th ed., 2013, WileyIndia Pvt.Ltd, New Delhi.

d. Organic chemistry- Cram and Hammered, Pine Hendrickson, 5th ed.,2012, Tata Mc Graw Hill Publishing Pvt Ltd. New Delhi

3. Lecture wise programme:

	Topics	**Hrs**
1	Structures and Physical properties: a) Polarity of bonds, polarity of molecules, M.P, Inter molecular forces, B.P, Solubility, non ionic solutes and ionic solutes, protic and aprotic Solvents, ion airs, b) Acids and bases, Lowry bronsted and Lewis theories c) Isomerism	05
2	Nomenclature of organic compound belonging to the following classes Alkanes, Alkenes, Dienes, Alkynes, Alcohols, Aldehydes, Ketones, Amides, Amines, Phenols, Alkyl Halides, Carboxylic Acid, Esters, Acid Chlorides and Cycloalkanes.	08
3	Free radicals chain reactions of alkane : Mechanism, relative reactivity and stability	02
4	Alicyclic compounds: Preparations of cyclo alkanes, Bayer strain theory and orbital picture of angle strain.	04
5	Nuclophilic aliphatic substitution mechanism: Nucleophiles and leaving groups, kinetics of second and first order reaction, mechanism and kinetics of SN2	06

	reactions. Stereochemistry and steric hindrance, role of solvents, phase transfer catalysis, mechanism and kinetics of SN1 reactions, stereochemistry, carbocation and their stability, rearrangement of carbocation, role of solvents in SN1 reaction, SN2 versus SN1.	
6	Dehydro halogenation of alkyl halides: 1,2 elimination, kinetics, E2 and E1 mechanism, elimination via carbocation, evidence for E2 mechanism, absence of rearrangement isotope effect, absence hydrogen exchange, the element effect, orientation and reactivity, E2 versus E1, elimination versus substitution, dehydration of alcohol, ease of dehydration, acid catalysis, reversibility, orientation.	05
7	Electrophillic and free radicals addition: Reactions at carbon - carbon, double bond, electrophile, hydrogenation,heat of hydrogenation and stability of alkenes, markownikoff rule, addition of hydrogen halides, additionof hydrogen bromides, peroxide effect, electrophillic addition, mechanism, rearrangement, orientation andreactivity, addition of halogen, mechanism, halohydinformation, mechanism of free radicals additon, mechanismof peroxide initiated addition of hydrogen bromide,orientation of free addition, additions of carbene to alkene,cyclo addition reactions.	06
8	Carbon-carbon double bond as substituents: Free radical halogenations of alkenes, comparision of free radical substitution with free radical addition, free radical substitution in alkenes, orientation and reactivity, allylicrearrangements.	04
9	Theory of resonance: Allyl radical as a resonance hybrid, stability,orbital picture, resonance stabilisation of allyl radicals, hyper conjugation, allyl cation as a resonance hybrid, nucleophyllic substitution in allylic substrate, SN1 reactivity, allylic rearrangement, resonance stabilisation of allyl cation, hyper conjugation, nucleophilic substitution in allylic substrate, stability of conjugated dienes, resonance in alkenes, hyper conjugation, ease of formation of conjugated dienes, orientation of elimination, electrophilic addition to conjugated dienes, 1,4 - addition, 1,2-versus 1,4-addition, rate versus equilibrium, orientation and reactivity of free radical addition to conjugated dienes.	05

10	Elecrophilic aromatic substitution: Effect of substituent groups, determination of orientation, determination ofrelative reactivity, classification of substituent group,mechanism of nitration, sulphonation, halogenation,friedel craft alkylation, friedel craft acylation, reactivityand orientation, activating and deactivating O,P,Mdirecting groups, electron release via resonance, effect of halogen on electrophilic aromatic substitution in alkylbenzene, side chain halogination of alkyl benzene,resonance stabilization of benzyl radical.	06
11	Nucleophilic addition reaction: Mechanism, ionisation of carboxylic acids, acidity constants, acidity of acids,structure of carboxylate ions, effect of substituent onacidity, nucleophilic acyl substitution reaction, conversionof acid to acid chloride, esters, amide and anhydride. Roleof caboxyl group, comparison of alkyl nucleophilic substitution with acyl nucleophilic substitution.	05
12	Mechanism of aldol condensation, claisen condensation, cannizzaro reaction, crossed aldol condensation, crossed cannizzaro reaction, benzoin condensation, perkin condensation. Knoevenagel, Reformatsky reaction, Wittigreaction, Michael addition.	05
13	Hoffman rearrangement: Migration to electr on deficient nitrogen, Sandmeyer's reaction, basicity of amines, diazotisation and coupling, acidity of phenols, Williamson synthesis, Fries rearrangement, Kolbe reaction, Reimer tieman's reactions.	04
14	Nucleophilic aromatic substitution: Bimolecular displacement mechanisms, orientation, comparison of aliphatic nucleophilic substitution with that of aromatic.	03
15	Oxidation reduction reaction with examples	02
16	Study of the following official compounds- preparation, test for purity, assay and medicinal uses of Chlorbutol, Dimercaprol, Glyceryl trinitrate, Urea, Ethylene diamine dihyrate, Vanillin, Paraldehyde, Ethylene chloride, Lactic acid, Tartaric acid, citric acid, salicylic acid, aspirin, methyl salicylate, ethyl benzoate, benzyl benzoate, dimethyl pthalate, sodium lauryl sulphate, saccharin sodium, mephensin.	05

22PD14P: PHARMACEUTICAL ORGANIC CHEMISTRY (PRACTICAL)

Practical : 3 Hrs./Week **75 Hours**

I. Introduction to the various laboratory techniques through demonstration involving synthesis of the following compounds (at least 8 compounds to be synthesised):

1. Acetanilde / aspirin (Acetylation)
2. Benzanilide / Phenyl benzoate (Benzoylation)
3. P-bromo acetanilide / 2,4,6 – tribromo aniline(Bromination)
4. Dibenzylidene acetone (Condensation)
5. 1-Phenylazo-2-napthol (Diazotisation and coupling)
6. Benzoic acid / salicylic acid (Hydrolysis of ester)
7. M-dinitro benzene (Nitration)
8. 9, 10 – Antharaquinone (Oxidation of anthracene) / preparation ofbenzoic acid from toluene or benzaldehyde
9. M-phenylene diamine (Reduction of M-dinitrobenzene)/Aniline from nitrobenzene
10. Benzophenone oxime
11. Nitration of salicylicacid
12. Preparation of picricacid
13. Preparation of O-chlorobenzoic acid from O-chlorotolune
14. Preparation of cyclohexanone from cyclohexanol

II. Identification of organic compounds belonging to the following classes by : Systematic qualitative organic analysis including preparation of derivatives phenols, amides, carbohydrates, amines, carboxylic acids, aldehyde and ketones, alcohols, esters, hydrocarbons, anilides, nitrocompounds.

III Introduction to the use of stereo models:

Methane, Ethane, Ethylene, Acetylene, Cis alkene, Trans alkene, inversionof configuration.

Scheme of Practical Examination:

	Sessionals	**Annual**
Synopsis	05	15
Major Experiment	10	25
Minor Experiment	03	15
Viva	02	15
Max Marks	**20**	**70**
Duration	**03 hrs**	**04 hrs**

Note: Total sessional marks is 30 (20 for practical sessional plus 10 marks for regularity,promptness, viva-voce and record maintenance).

22PD15T: PHARMACEUTICAL INORGANIC CHEMISTRY (Theory)

Theory: 2 hrs/Week **50 Hours**

Course Outcome

At the end of the course students will be able to...

CO No.	Outcome statement
CO1	Sources of errors, types of errors, methods of minimizing errors, accuracy, precision and significant figures.
CO2	Explain the various methods of expressing concentration and requirement of primary standards and Describe the preparation and standardization of different reagents used in volumetric analysis
CO3	Explain the principle of acid base, redox, nonaqueous titration with examples.
CO4	Describe the principle of precipitation, complexometric and gravimetric estimation with examples
CO5	Explain the sources of impurities and methods to determine the impurities in inorganic pharmaceuticals
CO6	Explain the method of preparation, assay, properties, medicinal uses of Medicinal Gases, acidifiers, antacids, cathartics, Major extra and intracellular electrolytes.
CO7	Explain the method of preparation, assay, properties, medicinal uses of, antimicrobials, trace elements, pharmaceutical aids, dental products and miscellaneous compounds
CO8	Describe the properties, storage condition and application of radiopharmaceuticals.

1. **Scope and objectives**: This course mainly deals with fundamentals of analytical chemistry and also the study the Inorganic pharmaceuticals regarding their monographs and also the course deals with basic knowledge of analysis ofvarious pharmaceuticals.

   Upon completion of course student shall be able to:

   1. understand the principles and procedures of analysis of drugs and alsoregarding the application of inorganic pharmaceutical;
   2. know the analysis of the inorganic pharmaceuticals their applications

3. appreciate the importance of inorganic pharmaceuticals in preventing andcuring the disease.

2. Course materials:

Text books

a. A.H.Beckett & J.B. Stenlake's -Practical Pharmaceutical Chemistry Vol I &II, Stahl one Press of University of London, 4th edition.2007
b. Text Book of Quantitative Inorganic analysis by Vogel, 10th ed. 2014, Pearson
c. Inorganic Pharmaceutical Chemistry III-Edition P. GunduRao, 3rd, ed. 2017, Nirali prakashan, Newdelhi.

Reference books

a. A text book of Inorganic medicinal Chemistry by Surendra N. Pandey. 2011, K.G. Publisher, Varanasi
b. Inorganic pharmaceutical Chemistry by M.L Schroff
c. Bentely and Driver's Textbook of Pharmaceutical chemistry,8th Ed.,2007 Oxford University Press, Newyork
d. Pharmaceutical Analysis Vol – I, Dr. A.V. Kasture et al., Nirali Prakashan, 13 Edition. 2016
e. Inorganic Pharmaceutical Chemistry by Anand & Chatwal.5th ed. 2017, Himalaya Publication House, Mumbai
f. Analytical chemistry principles by John H. Kennedy.3rd ed.
g. Indian Pharmacopoeia 2018, 8th Edition (4 Volumes) . Govt. of India,Ministry of Health.

3. Lecture wise programme :

	Topics	**Hrs**
1	Sources of errors, types of errors, methods of minimizing errors, accuracy, precision and significant figures.	02
2	Fundamentals of volumetric analysis, theories of indicators and methods of expressing concentrations. Primary and secondary standard. Preparation and standardization of various volumetic solutions like sodium hydroxide, hydrochloric acid and sodiumthiosulphate.	04
3	**Acid base titration**: Classification and estimation of strong, weak, and very weak acids and bases.	02

4	**Principles of redox titrations:** Concepts of oxidation and reduction. 3Redox reactions, strength and equivalent weights of oxidizing and reducing agents, theory of redox titrations, cerrimetry, Iodimetry, Iodometry, bromometry, titrations with potassium iodate	0
5	**Non aqueous titration**: Introduction to solvents, classification and estimation of Sodium benzoate.	02
6	**Principles of precipitation titrations:** Different methods-Mohr's, Modified Mohr's, Volhard's, Modified Volhard's, Fajans with example. Estimation of sodium chloride by modified volhardsmethod.	03
7	**Complexometric titration and its classification**: Estimation of Calcium Gluconate by complexometric method. Metal ionindicators.	03
8	**Gravimetry**: Introduction to gravimetric method, steps involved in gravimetric method, precipitants and estimation of Barium sulphateby gravimetric method.	02
9	**Limit test:** Source and effect of impurities in pharmacopoeial substances, importance of limit test, general principle and procedures for limit test, limit test for chloride, sulphate, iron, arsenic and lead and heavy metals. Special procedure for limit testfor chloride and sulphate	06
	General methods of preparation, assays*, storage condition andMedicinal uses of inorganic compounds belonging to the following classes.	
10	**Medicinal gases:** Oxygen, Nitrous oxide, Carbon dioxide	01
11	**Acidifies**: Dil HCl	01
12	**Antacid**: Aluminum hydroxide gel, sodium bicarbonate*, Magnesium triisilicate, Magnesium carbonate (Light and Heavy),Magnesium hydroxide mixture*, Preparation containing combination of antacids.	03
13	**Cathartics**: Magnesium sulphate*, Sodium orthophosphate	01
14	**Major extra and intracellular electrolytes**: Functions of major physiological ions, Electrolytes used in the replacement therapy: Sodium chloride*, Sodium chloride Injection, Sodium chloride compound injection, Potassium chloride, Potassium chloride injection, Calcium Gluconate and Electrolyte combination therapy and ORS, Physiological acid base balance.	04
15	**Essential trace elements:** Copper, Iron, Iodine and Zinc	01

16	**Antimicrobials:** Potassium permanganate*, Hydrogen peroxide*, Chlorinated lime*, Iodine and its preparations, Boric acid*.	03
17	**Pharmaceutical aids:** Bentonite, sodium metabisulphite, Barium Sulphate	01
18	**Dental products:** Dentifrices, role of fluoride in the treatment of dental caries, Desensitizing agents, Calcium carbonate, Sodiumfluoride, Stannous fluoride, Zinc Eugenol cement.	02
19	**Miscellaneous compounds:** **i) Expectorants:** Potassium iodide*, Ammonium Chloride* **ii) Haematinics**: Ferrous sulphate*, Ferrous gluconate, Ferrousfumarate, **iii) Emetics**: Copper sulphate*, Sodium potassium tartarate **iv) Poison and Antidote**: Sodium thoisulphate, Activated charcoal	04
20	**Radiopharmaceuticals:** Radio activity, natural radio activity and artificial radio activity. Measurement of radioactivity, Properties of α, β, γ radiations, Half life, radio isotopes and study of radio isotopessodium iodide I-121, Ferric citrate Fe-59. Storage conditions, precautions & pharmaceutical applicationof radioactive substances.	02

22PD15P: PHARMACEUTICAL INORGANIC CHEMISTRY (PRACTICAL)

Practical: 3 Hours/week **75 Hours**

(Following experiments to be covered in 25 different practical classes)

1. Limit tests (7 exercises) *
    1. Limit test for chlorides
    2. Limit test for sulphate
    3. Limit test for Iron
    4. Limit test for heavy metals
    5. Limit test for Arsenic
    6. Modifications in limit tests for chloride and sulphates in potassium permanganate, sodium bicarbonate, sodium benzoate and sodium Salicylate.
2. Preparation and standardization of the following (3 exercises)*.
    1. 0.IN NaOH
    2. 0.IN $KMnO_4$
    3. 0.IN Cerric ammonium sulphate
    4. 0.IN $HClO_4$
    5. 0.05M Di sodium EDTA
    6. 0.IN Sodium thiosulphate
3. Assay of the following compounds **
    1. Ammonium chloride-acid base titration (Formal titration)
    2. Ferrous sulphate- (redox) Ceric ammonium sulphate titration
    3. Copper sulphate- (redox) Iodometry
    4. Calcium gluconate-complexometry
    5. Hydrogen peroxide- (redox -Permanganometry)
    6. Sodium benzoate-nonaqueous titration
    7. Sodium chloride-Modified Volhard's method
    8. Assay of KI-KIO_3 titration
    9. Assay of Zinc oxide (acid base back titration)
4. Test for identify for the following (2 exercises)* Sodium bicarbonate Ferrous sulphate Potassium iodide. Calcium chloride
5. Test for purity for the following (2 exercises)*
    1. Swelling power in Bentonite

2. Ammonium salts in Potash alum.
3. Presence of Iodates in KI

6. Preparation of inorganic pharmaceuticals (2 exercises)*
   1. Boric acid
   2. Potash alum
   3. Magnesium hydroxide.
   4. Magnesium sulphate

Scheme of Practical Examination	**Sessional**	**Annual**
Synopsis	05	15
Major Experiment(Experiment indicated by**)	10	25
Minor Experiment(Experiment indicated by*) 1&2	3	20
Viva-Voce	2	10
Max. Marks	20	70
Duration	**03 hrs**	**04 hrs**

Note: Total sessional marks is 30 (20 for practical sessional and 10 marks for regularity,promptness, viva-voce and record maintenance)

22PD16T: REMEDIAL MATHEMATICS/BIOLOGY (THEORY)

Theory : 3 Hrs. /Week **75 Hours**

REMEDIAL MATHEMATICS:

1. **Scope and objectives**: This is an introductory course in mathematics. This subjects deals with the introduction to matrices, determinants, trigonometry, analytical geometry, differential calculus, integral calculus, differential equations, laplace transform.

   Upon completion of the course the student shall be able to :

   1. Know Trigonometry, Analytical geometry, Matrices, Determinant, Integration, Differential equation, Laplace transform and their applications;
   2. solve the problems of different types by applying theory; and
   3. appreciate the important applications of mathematics in pharmacy.

2. **Course materials:**

   Text books

   a. Differential calculus By Shantinarayan
   b. Text book of Mathematics for second year pre-university byProf.B.M.Sreenivas

   Reference books

   a. Integral calculus By Shanthinarayan
   b. Engineering mathematics By B.S.Grewal
   c. Trigonometry Part-I By S.L.Loncy

3. **Lecture wise programme:**

	Topics	Hrs
1	**Algebra :** Matrices : Definition, Addition, Subtraction & Multiplication of matrices,Determinants: Determinants of order two and three, Properties of determinants (without Proof). Inverse of square Matrices, Adjoint of square matrix, Solution of linear equation by Matrix method, Cramer's rule, Characteristic equation, Statement of Cayley-Hamilton Theorem (Without Proof) – Pharmaceutical examples	18
2	**Trigonometry :** Relation between Sides and angles of a triangle, solution of triangles – Simple problems	05

3	**Analytical Geometry :**Points, Straight line, Types of straight lines – Y= mx + c, (y-y1) = m*(x-x1), (y-y1) = ((y2-y1)/(x2-x1))*(x-x1) Parallel and Perpendicular straight lines, Angle between two lines, Perpendicular distance from a point to the line, distance between parallellines, Circle: General equation of circle, finding centre and radius of the circle, Parabola: Equation of the parabola y2= 4ax , Simple problems	15
4	**Differential calculus:** Function, Limit, Differentiation, Differentiation of sum, Product, Quotient, Composite, Parametric, exponential, trigonometric and Logarithmic function. Successive differentiation, simple problems.	16
5	**Integral Calculus:** Partial fractions, Definition of integration, integration bysubstitution and integration by parts, Properties of definite integrals, Simple problems.	07
6	**Differential equations:** Definition, order, degree, variable separable, homogeneous differential equation, linear differential equation, exact differential equation, Simple problems	10
7	**Laplace transform:** Definition, Laplace transform of elementary functions, linearity and shifting property , simple problems	04

REMEDIAL BIOLOGY:

1. **Scope and objectives**: This is an introductory course in Biology, which gives detailed study of natural sources such as plant and animal origin. This subject hasbeen introduces to the pharmacy course in order to make the student aware of various naturally occurring drugs and its history, sources, classification, distribution and the characters of the plants and animals. This subject gives basicfoundation to Pharmacognosy.

2. **Course materials:**

Text books

a. Textbook Of Pharmaceutical Biology, SB Gokhale CK Kokate, VikashGupta, 7th ed. Nirali Prakashan,
b. A Text book of Biology by Dr.Thulajappa and Dr. Seetaram.

Reference books

a. A Text book of Biology by B.V.Sreenivasa Naidu
b. A Text book of Biology by Naidu and Murthy
c. Botany for Degree students By A.C.Dutta.
d. Outlines of Zoology by M.Ekambaranatha ayyer and T.N.Ananthakrishnan.
e. A manual for pharmaceutical biology practical by S.B.Gokhale andC.K.Kokate, 7th ed. 2012, Nirali Prakahsan, Pune.

3. **Lecture wise programme : PART – A**

Topics	**Hrs**
1. Introduction	02
2. General organization of plants and its inclusions	04
3. Plant tissues	04
4. Plant kingdom and its classification	04
5. Morphology of plants	04
6. Root, Stem, Leaf and Its modifications	05
7. Inflorescence and Pollination of flowers	04
8. Morphology of fruits and seeds	04
9. Plant physiology	04
10. Taxonomy of Leguminosae, umbelliferae, Solanaceae Lilliaceae, Zinziberaceae, Rubiaceae	06
11. Study of Fungi, Yeast, Penicillin and Bacteria	04

PART-B

Topics		**Hrs**
1.	Study of Animal cell	04
2.	Study animal tissues	04
3.	Detailed study of frog	08
4.	Study of Pisces, Reptiles, Aves	05
5.	General organization of mammals	05
6.	Study of poisonous animals	04

22PD16P: REMEDIAL BIOLOGY (PRACTICAL)

Practical : 3 Hrs./Week **75 Hours**

Title of Experiments

1. Introduction of biology experiments (sectioncutting techniques, Mounting andstaining, permanence slide preparation and Microscope)
2. Study of cell wall constituents and cell inclusions
3. Study of Stem modifications
4. Study of Root modifications
5. Study of Leaf modifications
6. Identification of Fruits and seeds
7. Preparation of Permanent slides
8. Simple plant physiological experiments
9. Identification of animals
10. Detailed study of Frog by using computer models
11. Computer based tutorials

Scheme of Practical Examination:

	Sessionals	**Annual**
Identification	04	10
Synopsis	04	10
Major Experiment	07	20
Minor Experiment	03	15
Viva	02	15
Max Marks	**20**	**70**
Duration	**03hrs**	**04hrs**

Note: Total sessional marks is 30 (20 for practical sessional plus 10 marks for regularity,promptness, viva-voce and record maintenance.

22PD17T: CONSTITUTION OF INDIA (THEORY)

Theory: 2 Hours per week **50 Hours**

SYLLABU

SUNIT – I

1. Constitution of India 10 Hours
   a. An introduction to Indian Polity
   b. Meaning and importance of Constitution
   c. Making of the Indian constitution – The Constituent Assembly
   d. Salient features of the Indian Constitution
   e. Preamble of the Indian Constitution and its significance
2. Fundamental Rights and Directive Principles 08 Hours
   a. Fundamental Rights
   b. Directive Principles of the State Policy
   c. Fundamental Duties

UNIT – II

1. Government of the Union 06 Hours
   a. The Union Executive- the President and the Vice-President- The Council ofMinisters and the Prime Minister
   b. The Union Legislature - The Parliament- The Lok Sabha and the RajyaSabha, composition, Powers and functions
   c. Important Committees -Privileges
   d. the Role of the Speaker
2. Government of the States 06 Hours
   a. The Governor- The Council of Ministers and the Chief Minister
   b. The State Legislature- composition powers and functions
3. Democratic decentralization or Panchayath Raj in India 02 Hours

UNIT – III

1. Federation in India 06 Hours
   a. Federal Features Indian federalism, Centre-State relations distribution of legislative powers, Administrative and financial relations between the Unionand the States

b. The Finance Commission, The Planning Commission, National DevelopmentCouncil

c. Military Features

2. The Judiciary 04 Hours

a. The Supreme Court – Organization, Jurisdiction and Role

b. The High Court – Organization, Jurisdiction and Role

c. Judicial Review, Judicial activism, Independence of Judiciary in India

UNIT – IV

1. Electoral Process in India – Election Commission, Organization and Functions 04 Hours

2. Local Governments – Rural and Urban – Organization, Powers and Role 04 Hours

Books for Reference:

1. D.D. Basu: Introduction to the Constitution of India, S C Sarkar & Sons,Kolkatta
2. M V Pylee: An Introduction to the Constitution of India, Vikas PublishingHouse Pvt Ltd, 2009
3. Granville Austin: The Indian Constitution. The Cornerstone of a Nation, OxfordUniversity Press, New Delhi, 1966
4. C K Jain (ed): Constitution of India in Precept and Practice, Lok Sabha Secretariat, New Delhi
5. V.N. Shukla: Constitution of India, Jain Book Depot, New Delhi
6. Granville Austin : The working of a Democratic Constitution: The IndianExperience, New Delhi, Oxford University Press, New Delhi 1999
7. J C Johari: Indian Politics, Vishal Publications, Jalandhar
8. A P Avasthi: Indian Government and Politics, Lakshmi Narain Agarwal, Agra
9. Anup Chand Kapur: Indian Government and Politics, S. Chand and Company,New Delhi
10. V D Mahajan: The Constitution of India. S. Chand and Company, New Delhi.
11. J N Pandey: Constitution Law of India, Allahabad, Central Law Agency, 1998
12. J C Johari: The Constitution of India – A Politico-Legal Study- Sterling Publication Pvt. Ltd, New Delhi
13. R C Agrawal: Constitutional Development and national Movement of India, SChand & Co., New Delhi
14. M Hidayatullah: Democracy in India and the Judicial Process,

Metropolitan,New Delhi

15. K C Markandan: Directive Principles in the Indian Constitution, AlliedPublishers, Mumbai
16. Bidyut Chakrabarty and Rajendra Kumar Pandey: Indian Government andPolitics, SAGE Publications New Delhi
17. India – A Politico-Legal Study- Sterling Publication Pvt. Ltd, New Delhi

22PD21T: PATHOPHYSIOLOGY (THEORY)

Theory: 3 Hrs. /Week **75 Hours**

Course Outcome

At the end of the course students will be able to...

CO No.	Outcome statement
CO1	Describe Basic principles of Cell injury Adaptation and explain the concept of inflammation and repair
CO2	Describe Diseases of Immunity a) Introduction to T and B cells b) MHC proteins or transplantation antigens c) Immune tolerance – Hypersensitivity,
CO3	Describe autoimmunity, Classifications of autoimmune diseases in man,mechanism of autoimmunity, allograft, and graft rejection mechanism AIDS, amylodosis
CO4	Classify and explain the etiology and pathogenesis of cancer
CO5	Describe the etiology and pathogenesis of shock , describe the biological effects of radiation Explain the pathogesesis of Environmental and nutritionaldiseases
CO6	Effects of i) Air pollution and smoking- SO2,NO, NO2, and CO ii) Protein calorie malnutrition, vitamins, obesity, pathogenesis of starvation.
CO7	Describe the etiology and pathogenesis of Pathophysiology of common diseases a. Parkinsonism b. Schizophrenia c. Depression and mania d. Hypertension, e. Stroke (ischaemic and hemorrhage) f. Angina, CCF, Atherosclerosis, Myocardial infarction g. Diabetes Mellitus h. Peptic ulcer and inflammatory bowel diseases i. Cirrhosis and Alcoholic liver diseases j. Acute and chronic renal failure k. Asthma and chronic obstructive airway diseases

CO8	Describe the etiology and pathogenesis of Infectious diseases Sexually transmitted diseases (HIV, Syphilis, Gonorrhea), Urinary tract infections, Pneumonia, Typhoid, Tuberculosis, Leprosy, Malaria Dysentery (bacterial and amoebic), Hepatitis- infective hepatitis.

1. **Scope and Objectives:** This course is designed to impart a thorough knowledge of the relevant aspects of pathology of various conditions with reference to its pharmacological applications, and understanding of basic Pathophysiological mechanisms. Hence it will not only help to study the

syllabus of pathology, but also to get baseline knowledge of its application inother subject of pharmacy.

Upon completion of the course student shall be able to -

1. Describe the etiology and pathogenesis of the selected disease states;
2. Name the signs and symptoms of the diseases; and
3. Mention the complications of the diseases.

2. Course Materials: Text books (Theory)

a. Pathologic basis of disease by- Cotran, Kumar, Robbins Elsiver India PvtLtd, Newdelhi, 2015, ed. 9 vol. 1-2
b. Text book of Pathology- Harsh Mohan, 7th ed. 2015, JaypeeBrothers Medical Publishers (P) Ltd., New Delhi,
c. Text book of Pathology- Y.M. Bhinde

Reference books (Theory)

a. Clinical Pharmacy and Therapeutics; 5th.ed. 2012; Walker & Whittlesea, Churchill Livingstone publication

3. Lecture wise Programme:

	Topics	Hrs
1	**Basic principles of cell injury and Adaptation** a) Causes, Pathogenesi s and morphology of cell injury b) Abnormalities in lipoproteinaemia, glycogen infiltration and glycogen infiltration and glycogen infiltration and glycogen storage diseases	05
2	**Inflammation** a) Pathogenesis of acute inflammation, Chemicalmediators in inflammation,Types of chronic inflammation b) Repairs of wounds in the skin, factors influencinghealing of wounds	05
3	**Diseases of Immunity** a) Introduction to T and B cells b) MHC proteins or transplantation antigens c) Immune tolerance - Hypersensitivity Hypersensitivity type I, II, III, IV, Biological significance, Allergy due to food, chemicals and drugs	10

	- Autoimmunity Criteria for autoimmunity, Classifications of autoimmune diseases in man, mechanism of autoimmunity, Transplantation and immunologic tolerance, allograft rejections, transplantation antigens,mechanism of rejection of allograft. - Acquired immune deficiency syndrome (AIDS) - Amylodosis	
4	**Cancer** Differences between benign and malignant tumors, Histological diagnosis of malignancy, invasions and metastasis, patterns of spread, disturbances of growth of cells, classification of tumors, general biology of tumors, spread of malignant tumors, etiology and pathogenesis of cancer.	05
5	**Shock** Types of shock, mechanisms, stages and management	03
6	**Biological effects of radiation**	02
7	**Environmental and nutritional diseases** i) Air pollution and smoking- SO2,NO, NO2, and CO ii) Protein calorie malnutrition, vitamins, obesity,pathogenesis of starvation	04
8	**Pathophysiology of common diseases** Parkinsonism Schizophrenia Depression and maniaHypertension Stroke (ischemic and hemorrhage) Angina, CCF, Atherosclerosis, Myocardial infarctionDiabetes Mellitus Peptic ulcer and inflammatory bowel diseasesCirrhosis and Alcoholic liver diseases Acute and chronic renal failure Asthma and chronic obstructive airway diseases	30
9	**Infectious diseases:** Sexually transmitted diseases (HIV, Syphilis, Gonorrhea), Urinary tract infections, Pneumonia, Typhoid, Tuberculosis, Leprosy, Malaria, Dysentery (bacterial and amoebic), Hepatitis- infective hepatitis.	11

Assignments:

1 Chemical Mediators of inflammation
2 Drug Hypersensitivity
3 Cigarette smoking & its ill effects
4 Biological Effects of Radiation
5 Etiology and hazards of obesity
6 Complications of diabetes
7 Diagnosis of cancer
8 Disorders of vitamins
9 Methods in Pathology-Laboratory values of clinical significance
10 Pathophysiology of Dengue Hemorrhagic Fever (DHF)

Format of the assignment

1 Minimum & Maximum number of pages.
2. Reference(s) shall be included at the end.
3. Assignment can be a combined presentation at the end of the academic year
4. It shall be computer draft copy.
5. Name and signature of the student
6. Time allocated for presentation may be 8+2 Min.

22PD22T: PHARMACEUTICAL MICROBIOLOGY (THEORY)

Theory: 3 Hrs. /Week **75 Hours**

Course Outcome

At the end of the course students will be able to...

CO No.	Outcome statement
CO1	Explain the anatomy, identification, growth factors of microorganisms which include bacteria, virus, and fungus.
CO2	Discuss the cultivation and identification of the microorganisms in the laboratory
CO3	Explain different methods of sterilization and its properties and applications in pharmaceutical microbiology
CO4	Discuss the concepts and types, antibody, antigen -antibody reactions
CO5	Define the terms bacterial vaccines, toxoids, immunization programme, importance of booster dose.
CO6	Identification of diseases by performing the diagnostic tests
CO7	Estimation of potency of antibiotic by various microbial assay
CO8	Understand infectious diseases its history, pathogenesis, treatment and control

1. **Scope & Objectives:** Microbiology has always been an essential component of pharmacy curriculum. This is because of the relevance of microbiology to pharmaceutical sciences and more specifically to pharmaceutical industry. Pharmaceutical biotechnology is the logical extension of pharmaceutical microbiology, which is expected to change the complete drug product scenario in the future.
   This course deals with the various aspects of microorganisms, its classification, morphology, laboratory cultivation identification and maintenance. Its also discusses with sterilization of pharmaceutical products, equipment, media etc. The course further discusses the immunological preparations, diseases its transmission, diagnosis, control and immunological tests.
   Upon completion of the course student shall be able to:
   1. Know the anatomy, identification, growth factors and sterilization of microorganisms;
   2. Know the mode of transmission of disease causing microorganism, symptoms of disease, and treatment aspect;
   3. Do estimation of RNA and DNA and there by identifying the source;
   4. Do cultivation and identification of the microorganisms in the

laboratory;

5. Do identification of diseases by performing the diagnostic tests; and
6. Depreciate the behavior of motility and behavioral characteristics of
7. microorganisms.

2. Course Materials: Text books (Theory)

a) Vanitha Kale and Kishor Bhusari "Applied Microbiology" HimalayaPublishing house Mumbai.3rd., 2015.
b) Mary Louis Turgeon "Immunology and Serology in Laboratory Medicines" 2nd edition, 1996 Mosby- Year book inc St. Louis Missouri.
c) Harsh Mohan, "Text book of Pathology" 3rd edition, 1998, B-3 Ansari RoadDaryaganj N. Delhi.

Reference books (Theory)

a) Prescot L.M., Jarley G.P Klein D.A "Microbiology" 2nd- edition Mc GrawHill Company Inc.
b) Rawlins E.A. "Bentley's Text Book of Pharmaceutics" Bailliere Tindals24-28 London 1988.
c) Forbisher "Fundamentals of Microbiology" Philadelphia W.B.Saunders.9th ed.
d) Prescott L.M. Jarley G.P., Klein D.A. "Microbiology." 2ndedition WMC Brown Publishers, Oxford. 1993.
e) War Roitt, Jonathan Brostoff, David male, "Immunology"3rd edition 1996,Mosby- year book Europe Ltd, London.
f) Indian Pharmacopoeia 2018, 8th Edition (4 Volumes). Govt. of India,Ministry of Health.

3. Lecture wise Programme:

	Topics	**Hrs**
1.	**Introduction to the science of microbiology**.	03
	Major divisions of microbial world and Relationship among them.	
2.	**Morphology & Physiology of Microorganisms**	07
	Different methods of classification of microbes and study ofBacteria, Fungi, Virus, Rickettsiae, Spirochetes.	
3.	**Growth & Nutrition**	08
	Nutritional requirements	
	Growth and cultivation of bacteria and virus.	
	Culture Media for aerobic and anaerobic bacteria & fungi.Maintenance of lab cultures.	

4.	**Isolation and Identification of Bacteria** Different methods-Staining reactions Biochemical reactions.Counting of bacteria -Total and Viable counting techniques.	08
5.	**Sterilization** Detailed study of different methods of sterilization with meritsand demerits. Sterilization methods for all pharmaceutical products. Detailed study of sterility testing of different pharmaceutical preparations. Validation of varioussterilization techniques.	08
6.	**Disinfectants** Study of disinfectants, antiseptics, fungicidal and virucidal agents. Factors affecting their action and mechanism of action. Evaluation of bactericidal, bacteriostatic, virucidal andpreservatives in pharmaceutical preparations.	07
7.	**Immunology** Definition, Classification, General principles of natural immunity, Phagocytosis, acquired immunity (active and passive). Antigens, chemical nature of antigens structure and formation of Antibodies, Antigen-Antibody reactions. Bacterial exotoxins and endotoxins. Significance of toxoids in active immunity, Immunization programme, and importance ofbooster dose.	12
8.	**Diagnostic tests** Schick's Test, Elisa test, Western Blot test, Southern BlotPCR Widal, QBC, Mantaux Peripheral smear. Study of malarial parasite.	07
9.	**Microbiological Assays** Microbial culture sensitivity Testing: Interpretation of results Principles and methods of different microbiological assays. Microbiological assay of Penicillin, Streptomycin and vitamin B2 and B12. Standardization of vaccines and sera.	05
10.	**Study of infectious diseases** Typhoid, Tuberculosis, Malaria, Cholera, Hepatitis, Meningitis, Syphilis & Gonorrhea and HIV	10

22PD22P: PHARMACEUTICAL MICROBIOLOGY (PRACTICAL)

Practical: 3 Hrs. /Week **75 Hours**

Title of the Experiment:

1. Study of apparatus used in experimental microbiology*.
2. Sterilisation of glass ware's. Preparation and sterilisation of media*
3. Staining techniques – Simple staining; Gram's staining; Negativestaining**
4. Study of motility characters*.
5. Enumeration of micro-organisms (Total and Viable)*
6. Study of the methods of isolation of pure culture.*
7. Bio chemical testing for the identification of micro*-organisms.
8. Cultural sensitivity testing for some micro-organisms.*
9. Sterility testing for powders and liquids.*
10. Determination of minimum inhibitory concentration.*
11. Microbiological assay of antibiotics by cup plate method.*
12. Microbiological assay of vitamins by Turbidometric method**
13. Determination of RWC.**
14. Diagnostic tests for some common diseases, Widal, malarial parasite.**

* Indicate minor experiment & ** indicate major experiment

Assignments:

1. Visit to some pathological laboratories & study the activities and equipment/instruments used and reporting the same.
2. Visit to milk dairies (Pasturization) and microbial laboratories (other sterization methods) & study the activities and equipment/instruments used and reporting the same.
3. Library assignments
    a. Report of recent microbial techniques developed in diagnosing some common diseases.
    b. Latest advancement developed in identifying, cultivating & handling of microorganisms.

Format of the assignment:

1. Minimum & Maximum number of pages.
2. It shall be computer draft copy.
3. Reference(s) shall be included at the end.
4. Name and signature of the student.
5. Assignment can be a combined presentation at the end of the academicyear.
6. Time allocated for presentation may be 8+2 Min.

Scheme of Practical Examination:

	Sessionals	**Annual**
Synopsis	05	15
Major Experiment**	10	25
Minor Experiment*	03	15
Viva	02	15
Max Marks	**20**	**70**
Duration	**03 hrs**	**04 hrs**

Note: Total sessional marks is 30 (20 for practical sessional plus 10 marks for regularity,promptness, viva-voce and record maintenance).

22PD23T: PHARMACOGNOSY & PHYTOPHARMACEUTICALS (THEORY)

Theory : 3 Hours/Week **75 Hour**

Course Outcome

At the end of the course students will be able to...

CO No.	Outcome statement
CO1	Describe the history and scope of Pharmacognosy
CO2	Describe the Cultivation, Collection, Processing, Storage and Conservation of Medicinal Plants
CO3	Describe the various cell wall constituents and cell inclusions
CO4	Describe the morphology and microscopy of different plant parts
CO5	Discuss regarding natural pesticides and their sources; describe the various plant fibers used in surgical dressings and related products
CO6	Describe the pharmacognosy and chemistry of carbohydrates, lipids, proteins and elaborate on their sources
CO7	Discuss the various therapeutic applications of herbs, poisonous plants; describe Herb-drug interaction, Edible Vaccines and Marine Pharmacognosy
CO8	Describe different types of secondary metabolites (Alkaloids, Glycosides, Essential oils, Flavonoids, Resins and Tannins), their general properties, classification, test for identification and isolation techniques

1. Scope and objectives: This subject has been introduced for the pharmacy course in order to make the student aware of medicinal uses of various naturally occurring drugs their history, sources, distribution, method of cultivation, active constituents, medicinal uses, identification tests, preservation methods, substitutes and adulterants.

Upon completion of the course student shall be able to:

1. Understand the basic principles of cultivation, collection and storage of crude drugs
2. Know the source, active constituents and uses of crude drugs and
3. Appreciate the applications of primary and secondary metabolites of the plant.

2. Course materials:

Text books

a. Pharmacognosy by G.E. Trease & W.C. Evans. 16th ed., 2009, SaundersElsevier

b. Pharmacognosy by C.K. Kokate, S.B. Gokhale & A.C. Purohit. 54thed. 2017,Nirali Prakashan, Pune.

Reference books

a. Pharmacognosy by R. Brady & V.E. Tyler.9th ed.,1988, L E A and Febiger,

b. Pharmacognosy by T.E. Wallis.5th ed. 2005, CBS Publishers and Distributors, New Delhi

c. Pharmacognosy by C.S. Shah & J.S. Quadry.17th ed. 2014,B.S.shahPrakashan,New delhi.

d. Pharmacognosy by M.A. Iyengar.11th ed. 2008, Manipal University, Manipal

3. Lecture wise programme:

	Topics	**Hrs**
1.	Introduction.	01
2.	Definition, history and scope of Pharmacognosy	02
3.	Classification of crude drugs viz. alphabetical, morphological, 03 taxonomical, chemical, pharmacological,and chemotaxonomical methods.	
4.	Cultivation, collection, processing and storage of crude drugs. Conservation of medicinalplants.	06
5.	Detailed methods of cultivation, collection and storage of following crude drugs a) Senna b) Cinchona c) Cardamom d) Opium e) Isapgol f) Ergot h) Ginger	07.
6.	Study of cell wall constituents and cell inclusions.	02
7.	Study of morphology and microscopy of different plants parts i. Leaf: Datura, Senna ii. Bark: Cinnamon (Cassia), Cinchaona iii. Wood: Quassia iv. Stem: Ephedra v. Root: Rauwolfia, Liquorice vi. Rhizome: Ginger, Podophyllum. vii. Flower buds: Clove. viii.Fruits: Coriander, Fennel	10

ix . Seeds: Isapgol, Nux Vomica.

8. Study of natural pesticides. Pyrethrum, Neem, Tobacco 02
9. Carbohydrate: 07
   a) Detailed study of Carbohydrates and related products.
   b) Biological source, method of production,chemical constituents, tests, uses and adulterants of
   i) Honey ii) Acacia iii) Agar iv) Sterculia v) Tragacanth vi) Cellulose and its products vii) Pectin viii) Guar gum ix) Sodium alginate.
10. Proteins: 03
   a) Definition classification, chemistry andmethod of analysis of proteins
   b) Study of collagen, Gelatin and its products
11. Lipids: 07
   a) Definition, sources, method extraction, chemistry and method of analysis of Lipids.
   b) Study of method of production, chemical constituents, tests, uses and adulterants of thefollowing drugs.
   i) Castor oil ii) Shark liver oil iii) Chaulmoogra oil iv) Wool fat v) Bees wax vi) Spermaceti vii) Cocoa butter viii) Olive oil
12. Therapeutic application of herbal drugs, poisonous plants,herbal- drug interaction, edible vaccines, marine Pharmacognosy. 04
13. Introduction, definition, classification, general properties, chemicaltests and general method of isolation of Alkaloids, Glycosides, Essential Oils, Flavonoids, Resins and Tannins. 15
14. Study of plants fibers used in surgical dressings and related products. 02
15. Different methods of adulteration of crude drugs and general methods of detection of adulterants. 04

22PD23P: PHARMACOGNOSY & PHYTOPHARMACEUTICALS (PRACTICAL)

Practical: 3 Hrs./Week **75 Hours**

General Requirements: Laboratory Napkin, Observation Book (150 pages), Zerobrush, Needle, Blade, Match box.

List of experiments:

1. Introduction of Pharmacognosy laboratory and experiments.
2. Macro, powder and microscopic study of Datura.
3. Macro, powder and microscopic study of Senna.
4. Macro, powder and microscopic study of Cassia Cinnamon.
5. Macro, powder and microscopic study of Cinchona
6. Macro, powder and microscopic study of Ephedra.
7. Macro, powder and microscopic study of Quassia.
8. Macro, powder and microscopic study of Clove
9. Macro, powder and microscopic study of Fennel.
10. Macro, powder and microscopic study of Coriander.
11. Macro, powder and microscopic study of Isapgol.
12. Macro, powder and microscopic study of Nux vomica.
13. Macro, powder and microscopic study of Rauwolfia.
14. Macro, powder and microscopic study of Liquorice.
15. Macro, powder and microscopic study of Ginger.
16. Macro, powder and microscopic study of Podophyllum.
17. Determination of Acid Value.
18. Determination of Saponification value and Iodine Value.
19. Chemical tests for Acacia and Tragacanth
20. Chemical tests for Agar and Starch
21. Chemical tests for Gelatin & Lipids (Castor oil, shark liver oil, Beer wax)
22. Isolation of Glycyrrhizin.
23. Isolation of Quinine.
24. Isolation of Volatile oil.
25. TLC of Quinine.

Scheme of Practical Examination:

	Sessionals	**Annual**
Synopsis	04	10
Identification	04	10
Major Experiment	07	20
Minor Experiment	03	15
Viva	02	15
Max Marks	**20**	**70**
Duration	**03 hrs**	**04 hrs**

Note: Total sessional marks is 30 (20 for practical sessional plus 10 marks for regularity,promptness, viva-voce and record maintenance).

22PD24T: PHARMACOLOGY – I (THEORY)

Theory: 3 Hrs. /Week **75 Hours**

Course Outcome

At the end of the course students will be able to...

CO No.	Outcome statement
CO1	Describe the history and scope of pharmacology, general pharmacology, pharmacokinetics, and pharmacodynamics.
CO2	Explain neurotransmission and the pharmacology of drugs acting on ANS
CO3	Describe the pharmacology of drugs acting on Cardio Vascular System
CO4	Explain the pharmacology of drugs acting on Central Nervous System
CO5	Explain the pharmacology of Local Anaesthetics.
CO6	Explain the pharmacology of drugs acting on Respiratory System
CO7	Explain the pharmacology of Hormones and their antagonist.
CO8	Explain the pharmacology of Autocoids and their Antagonist

1. **Scope & Objectives:** This subject will provide an opportunity for the student to learn about the drug with regard to classification, pharmacodynamic and pharmacokinetic aspects, adverse effects, uses, dose, route of administration, precautions, contraindications and interaction with other drugs. In this subject, apart from general pharmacology, drugs acting on autonomic nervous system, cardiovascular system, central nervous system, blood and blood forming agentsand renal system will be taught.

Upon completion of the course student shall be able to:

1. Understand the pharmacological aspect of drugs falling under the abovementioned chapters.
2. Handle and carry out the animal experiments.
3. Appreciate the importance of pharmacology subject as a basis of therapeutics.
4. Correlate and apply the knowledge therapeutically.

Text books (Theory)

a) Tripathi, K. D. Essentials of medical pharmacology. 6th edition, 2008.Publisher: Jaypee, Delhi.
b) Satoskar, R.S. and Bhadarkar, S.D. Pharmacology andPharmacotherapeutics. 20th edition, 2008. Publisher: Popular, Mumbai.
c) Rang, H.P. & Dale, M.M. Pharmacology. 5th edition, 2003. Publisher:Churchill living stone.

Reference books (Theory)

a) Goodman Gilman, A., Rall, T.W., Nies, A.I.S. and Taylor, P. Goodman and Gilman's The pharmacological basis of therapeutics.11th edition, 2006. Publisher McGraw Hill, Pergamon Press.
b) Craig, C.R. & Stitzel, R.E. Modern Pharmacology. 5th edition, 1997. Publisher: Little Brown Co.
c) Katzung, B.G. Basic and clinical pharmacology. 9th edition 2004. Publisher: Prentice Hall, Int.
d) Shargel and Leon. Applied Biopharmaceutics and Pharmacokinetics. Latest edition 2002. Publisher: Prentice Hall, London.

3. Lecture wise Programme:Topics Hrs

1. **General**

   Pharmacology 16

   a) Introduction, definitions and scope of pharmacology
   b) Routes of administration of drugs
   c) Pharmacokinetics (absorption, distribution, metabolism & excretion)
   d) Pharmacodynamics
   e) Factors modifying drug effects
   f) Drug toxicity – Basic concepts, acute, sub-acute & chronic toxicity.
   g) Pre-clinical evaluation
   h) Drug interactions

   ***Note*:** The term Pharmacology used here refers to the classification, mechanism of action, pharmacokinetics, pharmacodynamics, adverse effects, contraindications, therapeutic uses, interactions and dose and route of administration.

2. **Pharmacology of drugs acting on ANS** 09

   a) Introduction to neurotransmission
   b) Adrenergic and antiadrenergic drugs

c) Cholinergic and anticholinergic drugs
d) Neuromuscular blockers
e) Mydriatics and miotics
f) Drugs used in myasthenia gravis
g) Drugs used in Parkinsonism

3. **Pharmacology of drugs acting on cardiovascular system** 09
   a) Antihypertensives
   b) Anti-anginal drugs
   c) Anti-arrhythmic drugs
   d) Drugs used for therapy of Congestive Heart Failure
   e) Drugs used for hyperlipidaemias
4. **Pharmacology of drugs acting on Central Nervous System** 20
   a) Excitatory and inhibitory neurotransmitters of CNS
   b) General anesthetics
   c) Sedatives and hypnotics
   d) Anticonvulsants
   e) Analgesic and anti-inflammatory agents
   f) Psychotropic drugs
   g) Alcohol and methyl alcohol
   h) CNS stimulants and cognition enhancers
   i) Centrally acting skeletal muscle relaxants
   j) Drug dependence, abuse and tolerance. List of drugs causing such problems
5. **Pharmacology of Local anaesthetics** 02
6. **Pharmacology of Drugs acting on Respiratory tract** 05
   a) Bronchodilators
   b) Mucolytics
   c) Expectorants
   d) Antitussives
   e) Nasal Decongestants
7. **Pharmacology of Hormones and Hormone antagonists** 08
   a) Thyroid and Antithyroid drugs
   b) Insulin, Insulin analogues and oral hypoglycemic agents
   c) Sex hormones and oral contraceptives
   d) Oxytocin and other stimulants and relaxants
8. **Pharmacology of autocoids and their antagonists** 06
   a) Histamines and Antihistaminics
   b) 5-Hydroxytryptamine and its antagonists
   c) Lipid derived autocoids and platelet activating factor

22PD25T: COMMUNITY PHARMACY (THEORY)

Theory: 2 Hrs. /Week **50 Hours**

Course Outcome

At the end of the course students will be able to...

CO No.	Outcome statement
CO1	Describe the business and professional practice management skills in community pharmacies
CO2	Analyse and manage the prescriptions in the community pharmacy
CO3	Management of various inventory control techniques in community pharmacy
CO4	Explain the pharmaceutical care services
CO5	Understand various methods of patient counselling.
CO6	Describe the methods of health screening
CO7	Recognize the minor ailments and develop the health promotions in the community
CO8	Explain the rational drug therapy

1. **Scope & Objectives:** This course is designed to ensure that students are skilled and knowledgeable to provide various pharmaceutical care services topatients and general practitioners in the community setup.
   Upon completion of the course, the student shall be able to:
   1. Handle the prescriptions and manage the community pharmacies
   2. Deliver the pharmaceutical care services in the community pharmacies.
   3. Respond to minor ailments and provide health education
   4. Promote rational drug therapy.

2. **Course Materials: Text Books:**
   a. Health Education and Community Pharmacy by N.S.Parmar.1st ed.2012,CBS
   b. WHO consultative group report.
   c. Drug store & Business management by Mohammed Ali & Jyoti.2017, CBS,Publishers & Distributors.

Reference books:

a. Handbook of pharmacy – health care. Edt. Robin J Harman. 2nd. ed. 2001,The Pharmaceutical Press.
b. Comprehensive Pharmacy Review – 7th ed. Leon Shargel. LippincottWilliams & Wilkins.

Special requirements:

1. Either the college is having model community pharmacy (meeting the schedule N requirement) or sign MoU with at least 4-5 community pharmacies nearby to the college for training the students on dispensingand counseling activities.
2. Special equipments like Sphygmomanometer, Glucometer, Peak flow meter, and apparatus for cholesterol estimation.

3. Lecture wise programme:

	Topics	**Hrs**
1.	**Definition and scope of community pharmacy** **Roles and responsibilities of Community pharmacist**	02
2.	**Community Pharmacy Management** a) Selection of site, Space layout, and design b) Staff, Materials- coding, stocking c) Legal requirements d) Maintenance of various registers e) Use of Computers: Business and health care softwares	04
3.	**Prescriptions** – parts of prescription, legality &identification of medication related problems like drug interactions.	02
4.	**Inventory control in community pharmacy** Definition, various methods of Inventory Control ABC,VED, EOQ, Lead time and safety stock	03
5.	**Pharmaceutical care**. Definition and Principles of Pharmaceutical care	02
6.	**Patient counselling** Definition, outcomes, various stages, barriers, strategies to overcome barriers Patient information leaflets- content, design, layouts & advisory labels	04
7.	**Patient medication adherence** Definition, Factors affecting medication adherence androle of pharmacist in improving the adherence	02
8.	**Health screening services** Definition, importance, methods for screening blood pressure/ blood sugar/lung function and Cholesterol	03

	testing		
9.	**OTC Medication - Definition, OTC medication list & Counselling**	03	
10.	**Health Education** WHO Definition of health and health promotion, care for children, pregnant & breast feeding women and geriatric patients.	02	
11.	Commonly occurring communicable diseases, causative agents, Clinical presentations and prevention of communicable diseases – Tuberculosis, Hepatitis, Typhoid, Amoebiasis, Malaria, Leprosy, Syphilis, Gonorrhea and AIDS		09
12.	Balance diet, treatment & prevention of deficiency disorders	02	
13.	Family planning – role of pharmacist	01	
14.	Responding to symptoms of minor ailment Relevant	08	
15.	pathophysiology and common drug therapy to Pain, GI disturbances (Nausea, Vomiting, Dyspepsia, diarrhea, constipation), Pyrexia, Opthalmic symptoms and worms infestations.		
16.	**Essential Drugs concept and Rational** Drug Therapy Role of **community pharmacist**	02	
17	**Code of ethics for community pharmacists**	01	

22PD26T: PHARMACOTHERAPEUTICS-I (THEORY)

Theory: 3 Hrs. /Week **75 Hours**

Course Outcome

At the end of the course students will be able to...

CO No.	Outcome statement
CO1	Describe the etiopathogenesis of selected disease states
CO2	Discuss the various methods involved in the diagnosis of selected disease state
CO3	Interpret and analyze the selected laboratory results of specific disease states
CO4	Describe the therapeutic approach to manage the selected diseases
CO5	Discuss the rationale for drug therapy of the selected disease
CO6	Identify the controversies in drug therapy
CO7	Develop the individualized therapeutic plans based on diagnosis
CO8	Describe the general prescribing guidelines for special population
CO9	Explain role of pharmacist in promoting rational drug use and essential drug concept

1. **Scope and Objectives:** This course is designed to impart knowledge and skills necessary for contribution to quality use of medicines. Chapters dealt cover briefly pathophysiology and mostly therapeutics of various diseases. This will enable the student to understand the pathophysiology of common diseases andtheir management.

   At completion of this course it is expected that students will be able to understand:

   1. The pathophysiology of selected disease states and the rationale for drugtherapy
   2. The therapeutic approach to management of these diseases
   3. The importance of preparation of individualized therapeutic plans based on diagnosis
   4. Needs to identify the patient-specific parameters relevant in initiating drug therapy, and monitoring therapy (including alternatives, time-course of clinical and laboratory indices of therapeutic response and adverse effects)
   5. Describe the pathophysiology of selected disease states and explain the

rationale for drug therapy

6. Summarise the therapeutic approach to management of these diseases including reference to the latest available evidence
7. Discuss the controversies in drug therapy
8. Discuss the preparation of individualised therapeutic plans based on diagnosis
9. Identify the patient-specific parameters relevant in initiating drug therapy, and monitoring therapy (including alternatives, time-course of clinical and laboratory indices of therapeutic response and adverse effects)

2 Course Materials: Text Books:

a) Clinical Pharmacy and Therapeutics; 5th.ed. 2012; Walker & Whittlesea, Churchill Livingstone publication

b) Pharmacotherapy: A Pathophysiology approach - Joseph T. Dipiro et al.10th ed.,2016, Appleton & Lange

Reference Books

a) Pathologic basis of disease by- Cotran, Kumar, Robbins Elsiver India Pvt Ltd,
Newdelhi,2015, ed. 9 vol. 1-2

b) Pathology and Therapeutics for Pharmacists - A Basis for Clinical Pharmacy Practice - Green and Harris, 3rd. ed.,Chapman and Hall publication

c) Clinical Pharmacy and Therapeutics – Eric T. Herfindal, 5th ed. 2016, Williams and Wilkins Publication

d) Applied Therapeutics: The clinical Use of Drugs. Lloyd Young and Koda- Kimble MA, 10th ed. 2013, Wolters Kluwer Lippincot williams &Wilkins,
Newyork

e) Avery's Drug Treatment, 4th Ed., 1997, Adis International Limited.

f) Relevant review articles from recent medical and pharmaceuticalliterature.

3 Lecture wise Programme

Etiopathogenesis and pharmacotherapy of diseases associatedwith following systems/ diseases

	Topics	**Hrs**
1.	**Cardiovascular system** Hypertension, Congestive cardiac failure, Angina Pectoris, Myocardial infarction, Hyperlipidemia, Electrophysiology of heart and Arrhythmias	26
2.	**Respiratory system** Introduction to Pulmonary function test, Asthma, Chronic obstructive airways disease, Drug inducedpulmonary diseases	12
3.	**Endocrine system** Diabetes, Thyroid diseases, Oral contraceptives,Hormone replacement therapy, Osteoporosis	16
4.	**General prescribing guidelines for** 4.1 Paediatric patients 4.2 Geriatric patients 4.3 Pregnancy and breast feeding	10
5.	**Ophthalmology:** Glaucoma, Conjunctivitis- viral & bacterial	06
6.	**Introduction to rational drug use** Definition, Role of pharmacist in promoting rationaldrug use and essential drug concept.	05

22PD26P: PHARMACOTHERAPEUTICS-I (PRACTICAL)

Practical: 3 Hrs. /Week **75 Hours**

Hospital postings in various departments designed to complement the lectures by providing practical clinical discussion; attending ward rounds; follow up the progress and changes made in drug therapy in allotted patients; case presentation upon discharge. Students are required to maintain a record of cases presented andthe same should be submitted at the end of the course for evaluation. A minimum of 15 cases should be presented and recorded covering most common diseases.

Assignments

Students are required to submit written assignments on the topics given to them. Topics allotted should cover recent developments in drug therapy of various diseases. A minimum of THREE assignments [1500 – 2000 words] should be submitted forevaluation.

Assignments

Format of the assignment

- Minimum & Maximum number of pages.
- It shall be computer draft copy
- Reference(s) shall be included at the end.
- Name and signature of the student
- Assignment can be a combined presentation at
- Time allocated for presentation may be the end of the academic year 8+2 min

Scheme of Practical Examination

	Sessionals	**Annual**
Synopsis	05	15
Major Experiment	10	25
Minor Experiment	03	15
Viva	02	15
Max Marks	**20**	**70**
Duration	**03 hrs**	**04 hrs**

Note: Total sessional marks is 30 (20 for practical sessional plus 10 marks for regularity,promptness, viva-voce and record maintenance)

22PD27T: HUMAN RIGHTS, GENDER EQUITY AND ENVIRONMENTAL STUDIES (THEORY)

Theory: 2 Hours per Week **50 Hours**

UNIT – I: **HUMAN RIGHTS**

1. **Human Rights** – Meaning; Universal Declaration of Human Rights 04 Hours
2. **Human Rights Advocacy:** Global Advocacy of Human Rights; 07 HoursAmnesty International and other organization ; People's Union for Civil Liberty (PUCL); Human Rights Commission in India; Minority Commission in India; Remedies against violation of HumanRights in India
3. **United Nations and Human Rights:** Civil and Political Rights: 04 HoursEconomic, Social and Cultural Rights

UNIT II: GENDER EQUITY

1. **Sex and Gender** – Masculinity and Feminity – Patriarchy, 04 HoursMatriarchy, Gender Roles and Attributes, Gender Division of Labour – Gender bias, Gender Stereotypes – Need for GenderSensitization
2. **Women's Status in India:** Important indicators – sex ratio, 04 Hourseducation, health, nutrition, maternal and infant mortality, work participation rates, political participation
3. **Contemporary Women's issues:** Discrimination against girl child; 04 HoursViolence against women; Problems of Health and Nutrition; Women's Education and gender bias in education; Trafficking ofWomen; Globalization and impact on women
4. **State Initiative on Gender Issues:** Constitution rights of women; 04 HoursLaws pertaining to women; National and State Commission for women

UNIT III: ENVIRONMENTAL STUDIES

1. **Environment:** Components of Environment Concepts of Ecology; 05 HoursEcological factors: Soil, air, water; Eco System – Pond and Forest as Ecosystem; Human Population Growth
2. **Environmental Pollutions:** Types of Pollution – a) soil, air, water 07 Hours b) noise and radioactive pollution; Sources of Pollution and theireffects**;** Control measures: Legal and administrative

3. **Conservation and Preservation of Environment:** Natural resources and their conservation – water, soil and forest; Agencies involved in environmental protection in India**;** Environmental Movements in India**;** Legal and administrative measures forenvironmental protection 07 Hours

BOOKS FOR REFERENCE:

A. Human Rights

1. S. Davidson: Human Rights, Buckingham, Open University,
2. Nirmal Chiranjivi: Human Rights in India, New Delhi, OxfordUniversity Press

B. Gender Equity

1. Usha Sharma (ed): Gender Mainstreaming and Women's Rights,Authors press, New Delhi, 2004
2. Mohini Chatterjee: Feminism and Gender Equity, AavishkarPublishers Jaipur
3. Neera Desai and Maithreyi Krishnaraaj, Women's Studies in India:Some perspectives. Popular Prakashan, Mumbai, 1986
4. Desai Neera and Thakkar Usha: Women in Indian Society, NationalBook Trust, India, 2001
5. Tharabai S.B: Women's Studies in India, APH Publication Corporation, New Delhi, 2000
6. Sushma Yadav and Anil Datta: Gender Issues in India, Radha Publications, New Delhi, 2003

C. Environmental Studies

1. N.K. Chakravarthy: Environmental Protection and Law, Ashis Publishing House, New Delhi
2. Eugene P. Odum: Basic Ecology, Savndus College, London
3. Kumar N: Air Pollution and Environmental Protection, Mittal Publication, New Delhi
4. Trivedi R K and Singh, UK: Environmental Laws on Wild Life, MittalPublication, New Delhi
5. K.A. Agarwal: Wild Life in Indian Conservation and Management, Nishi Publications
6. Erach Baruch: Text Book For Environmental Studies, UGC, NewDelhi and Bharati Vidyapeeth Institute Environment Education and

Research, Pune
7. Erach Baruch: The Biodiversity of India, Mapin Publishing Pvt Ltd.,Ahmedabad
8. Jadhav H & Bhosale, VM: Environmental Protection andLaws, Himalaya Publishing House, New Delhi
9. Trivedi R K and PK Goel: Introduction to Air Pollution, Techno-Science Publication

22PD31T: PHARMACOLOGY – II (THEORY)

Theory: 3 Hrs. /Week **75 Hours**

Course Outcome

At the end of the course students will be able to...

CO No.	Outcome statement
CO1	Explain the pharmacology drugs acting on blood and blood forming agents
CO2	Explain the drugs acting on urinary system
CO3	Discuss pharmacology drugs acting on GI system
CO4	Explain pharmacology of chemotherapeutic agents
CO5	Explain pharmacology drugs acting on immune system
CO6	Discuss principles of toxicology and bioassay
CO7	Discuss Structure and functions of the components of the cell.
CO8	Discuss different aspects of genes and their regulatory functions.

1. **Scope and Objectives:** This subject will provide an opportunity for the student to learn about the drug with regard to classification, pharmacodynamic and pharmacokinetic aspects, adverse effects, uses, dose, route of administration, precautions, contraindications and interaction with other drugs. In this subject, drugs acting on autacoids, respiratory system, GIT, immune system, hormones, pharmacology of autocoids and different aspects of genes will be concentrated. In addition, pharmacology of chemotherapeutic agents and principles of toxicology are also taught. In addition to theoretical knowledge, the basic practical knowledge relevant to therapeutics will be imparted.

   Upon completion of the subject student shall be able to:

   1. Understand the pharmacological aspects of drugs falling under theabove mentioned chapters.
   2. Carry out the animal experiments confidently.
   3. Appreciate the importance of pharmacology subject as a basis oftherapeutics.
   4. Correlate and apply the knowledge therapeutically.
   5. Understand different aspects of genes and their regulatory functions.

2. Course materials: Text books (Theory)

a) Tripathi, K. D. Essentials of medical pharmacology. 8th edition, 2018.Publisher: Jaypee, Delhi.
b) Satoskar, R.S. and Bhadarkar, S.D. Pharmacology and Pharmacotherapeutics. 24th edition (single volume), 2015. Publisher: Popular, Mumbai.
c) Rang, H.P. and Dale, M.M. Pharmacology. 8th edition, 2016. Publisher:Churchill Living stone.
d) Alberts, B., Bray, D., Lewis, J., Raff M., Roberts, K and Watson, JD Molecular Biology of the Cell by, 6th. Edition, 2012, Publisher: GarlandScience.

Reference books (Theory)

a) Goodman Gilman, A., Rall, T.W., Nies, A.I.S. and Taylor, P. Goodman and Gilman's The pharmacological basis of therapeutics. 12th edition, 2014. Publisher: McGraw Hill, Pergamon press.
b) Craig, C.R. and Stitzel, R.E. Modern Pharmacology. 6th edition 2012. Publisher: Little Brown and company.
c) Katzung, B.G. Basic and clinical pharmacology. 14th edition 2014. Publisher: Prentice Hall, International.
d) Gupta, P.K. and Salunkhe, D.K. Modern Toxicology. Volume I, II and **III.**2010. Publisher: B.V. Gupta, Metropolitan Book Co. (p) Ltd, New Delhi.
e) Crommelin, DJA and Sindelar RD. Pharmaceutical Biotechnology. 3rdedition 2008. Publisher: Infarma Healthcare.
f) Watson, JD., Gilman, M., et al. Recombinant DNA. 3nd edition 2008.Publisher: Scientific America.
g) Walsh, G. Biopharmaceutical: Biochemistry and Biotechnology. 2013.Publisher: John Wily.
h) Derelanko MG. Handbook of toxicology. 3rd edition 2014; Publisher:CRC Press.

Text books (Practical)

a) Kulkarni, S. K. and Dandia, P. C. Hand book of experimental pharmacology. 2012, Vallabha prakashan, Delhi.

Reference books (Practical)

a) Macleod, L.J. Pharmacological experiments on intact preparations 1970: Churchill livingstone.
b) Macleod, L.J. Pharmacological experiments on isolated preparations.,1970,: Churchill livingstone.
c) Ghosh, M.N. Fundamentals of experimental pharmacology. 6rd edition,2015; Publisher: Scientific book agency, Kolkata.
d) Ian Kitchen. Textbook of in vitro practical pharmacology.1984.Publisher: Black well Scientific.

3. Lecture wise Programme:

Topics	**Hrs**
1. **Pharmacology of drugs acting on Blood and blood forming agent**	06
a) Anticoagulants	
b) Thrombolytics and antiplatelet agents	
c) Haemopoietics and plasma expanders	
2. **Pharmacology of drugs acting on Renal System**	03
a) Diuretics	
b) Antidiuretics	
3. **Pharmacology of drugs acting on Gastrointestinal Tract**	06
a) Antiulcer drugs, Antacids	
b) Laxatives and purgatives	
c) Emetics and antiemetics	
d) Appetizers, digestants and carminatives	
4. **Chemotherapy**	22
a) Introduction	
b) Sulfonamides and co-trimoxazole	
c) Penicillins and Cephalosporins	
d) Tetracyclins and Chloramphenicol	
e) Macrolides, Aminoglycosides, Polyene & Polypeptide antibiotics	
f) Quinolines and Fluroquinolines	
g) Antifungal antibiotics	
h) Antiviral agents	
i) Chemotherapy of tuberculosis and leprosy	
j) Chemotherapy of Malaria	
k) Chemotherapy of protozoal infections (amoebiasis, giardiasis)	
l) Pharmacology of Anthelmintic drugs	
m) Chemotherapy of cancer (Neoplasms)	

5. **Immunopharmacology** 03
   Pharmacology of immunosuppressants and stimulants
6. **Principles of Animal toxicology** 02
   a) Acute, subacute and chronic toxicity.
   b) Principles involved in the various toxicityscreening methods available for drugs in the laboratory animals.
7. **The dynamic cell: The structures and functions of the components of the cell** 11
   a) Cell and macromolecules: Cellular classification, subcellularorganelles, macromolecules, large macromolecular assemblies
   b) Chromosome structure: Pro and eukaryotic chromosome structures, chromatinstructure, genome complexity, the flow of genetic information.
   c) DNA replication: General, bacterial and eukaryotic DNAreplication.
   d) The cell cycle: Restriction point, cell cycle regulators and modifiers.
   e) Cell signaling: Communication between cells and their environment, ion-channels, signal transduction pathways (MAP kinase, P38 kinase, JNK, Ras and PI3-kinase pathways, biosensors.
8. **The Gene: Genome structure and function:** 18
   a. Gene structure: Organization and elucidation of genetic code.
   b. Gene expression: Expression systems (pro and eukaryotic), genetic elements that control gene expression (nucleosomes, histones, acetylation, HDACS, DNA binding protein families.
   c. Transcription and Transcription factors: Basic principles of transcription in pro and eukaryotes. Transcription factors that regulate transcription in pro and eukaryotes.
   d. RNA processing: rRNA, tRNA and mRNA processing.
   e. Protein synthesis: Mechanisms of protein synthesis, initiation in eukaryotes, translation control and post-translation events
   f. Altered gene functions: Mutations, deletions, amplifications, LOH, translocations, trinucleotide repeats and other genetic abnormalities. Oncogenes and tumor suppressor genes.
   g. The gene sequencing, mapping and cloning of human disease genes.
   h. Introduction to gene therapy and targeting.

i. Recombinant DNA technology: principles. Processes (gene transfer technology) and applications

9. **Bio-assay methods** 04

Scope, principles involved in general methods, bioassay designing, applications and limitations.

22PD31P: PHARMACOLOGY – II (PRACTICAL)

Practical: 3 Hrs./Week **75 Hours**

List of Experiments:

1. Study of laboratory animals and their handling (a. Frogs, b. Mice, c. Rats, d. Guinea pigs, e. Rabbits).
2. Study of physiological salt solutions used in experimentalpharmacology.
3. Study of laboratory appliances used in experimental pharmacology.
4. Study of use of anesthetics in laboratory animals.
5. To record the dose response curve of Acetylcholine usingisolated rat ileum/rectus abdominis muscle preparation.
6. To carry out bioassay of Ach using isolated rat ileum/rectus abdominismuscle preparation by interpolation method.
7. To carry out bioassay of Ach using isolated ileum/rectus abdominismuscle preparation by three point method.
8. To record the dose response curve of Histamine using isolated guinea-pig ileum preparation.
9. To carry out bioassay of Histamine using isolated guinea-pig ileumpreparation by interpolationmethod.
10. To carry out bioassay of Histamine using guinea-pig ileum preparationby three point method.
11. Study of agonistic and antagonistic effects of drugs using isolated guinea-pig ileum preparation.
12. To study different routes of administration of drugs in animals (Rats,Mice, Rabbits).
13. Study of theory, principle, procedure involved and interpretation of givenresults for the following experiments:
    a. Analgesic property of drug using analgesiometer (tail flick andhotplate).
    b. Antiinflammatory effect of drugs using rat-paw edema method.
    c. Anticonvulsant activity of drugs using maximal electroshock andpentylene tetrazole methods.
    d. Antidepressant activity of drugs using pole climbing apparatus.
    e. Pentobarbitone induced sleeping time in mice.
    f. Locomotor activity of drugs using actophotometer.
    g. Cardiotonic activity of drugs using isolated frog heart and mammalianheart preparations.

h. Skeletal muscle relaxant activity of the drugs using rotarod.
i. Drugs effect on the blood pressure, heart rate and respiratory rate ofdog.

14. Simulated experiments
    a) Effect of drugs on frog's isolated heart.
    b) Effect of drugs on rabbit eye.
    c) Effect of drugs on ciliary motility of frog's esophagus.

Scheme of Practical Examination:

	Sessionals	**Annual**
Identification	02	10
Synopsis	04	10
Major Experiment (Bioassay)	08	30
Minor Experiment (Interpretation of given Graph/ simulatedexperiment)	04	10
Viva	02	10
Max Marks	**20**	**70**
Duration	**3 hrs**	**4 hrs**

Note: Total sessional marks is 30 (20 for practical sessional plus 10 marks for regularity,promptness, viva-voce and record maintenance).

22PD32T: PHARMACEUTICAL ANALYSIS (THEORY)

Theory: 3 Hrs. /Week **75 Hours**

Course Outcome

At the end of the course students will be able to...

CO No.	Outcome statement
CO1	Understand the construction and working of various analytical instruments
CO2	Know principle and mechanism of instrumentation
CO3	Understand the different modern techniques of drug analysis
CO4	Evaluate the advantages of instrumental methods of drug analysis
CO5	Estimate the drugs by Fluorimetric technique, Colorimetric technique & Nepheloturbidimetric Method
CO6	Perform Separation and identification of mixture of compounds using different Chromatography technique
CO7	Understand Potentiometrictitration and Conductometrictitration
CO8	Understand the advantage of calibration, validation & quality assurance

1. **Scope and objectives**: This course is designed to impart a fundamental knowledge on the art and science of testing drugs by various instrumental methods of analysis. This focuses on various modern instruments that are used for testing the purity of drugs in various dosage forms. This course also gives idea about modern instruments that are used for drug testing like NMR, IR, Mass, HPLC, HPTLC forms etc. It prepares the students for most basics of the applied field of pharmacy.

   At the end of course, students will be able:

   1. To understand the construction and working of various analytical instruments.
   2. To know principle and mechanism of instrumentation.
   3. To understand the different modern techniques of drug analysis.
   4. To appreciate the advantages of instrumental methods of drug analysis.

2. Course materials:

Text books

a. Instrumental methods of analysis by Willard, Merrit, Dean and Settlle 7th ed.2005, CBS publishers and distributors, New Delhi

b. A.H.Beckett & J.B. Stenlake's -Practical Pharmaceutical Chemistry Vol I &II, Stahl one Press of University of London, 4th edition.2007

Reference books

a. Text Book of Quantitative Inorganic analysis by Vogel, 10th ed. 2014, Pearson

b. Text book of Pharmaceutical Analysis by K.A. Cannors 3rd ed. 2007, Wiely,

c. Pharmaceutical analysis by Skoog and West. d. 9th Ed., 2010, William Kemp-Spectroscopy methods. Cengage

3. Lecture wise Programme

	Topics	**Hrs**
1	**Quality Assurance:** a. Introduction, sources of quality variation, control ofquality variation. b. Validation methods- quality of equipment, validation ofequipment and validation of analytical instruments and calibration.	06
2	**Chromatography:** Introduction, history, classification, separation techniques, choice of methods. The following techniques be discussed with relevant examples of pharmaceutical products involving principles and techniquesof separation of drugs from excipients. a. Column Chromatography: Adsorption column chromatography, Operational technique, frontal analysis and elution analysis. Factors affecting column efficiency, applications and partition chromatography. b. TLC: Introduction, principle, techniques, Rf value and applications. c. PC: Introduction, principle, types of paper chromatography, preparation techniques, development techniques, applications. d. Ion-exchange chromatography: Introduction, principles, types of ion exchange synthetic resins, physical properties, factors affecting ion exchange, methodology and applications. e. HPLC: Introduction, theory, instrumentation, and applications.	27

f. HPTLC: Introduction, theory, instrumentation, and applications.
g. Gas Chromatography: Introduction, theory, instrumentation carrier gases, types of columns, stationary phases in GLC & GSC. Detectors-Flame ionization detectors, electron capture detector, thermal conductivity detector. Typical gas chromatogram, derivatisation techniques, programmed temperature gas chromatography, applications.
h. Electrophoresis: Principles of separation, equipment for paper and gel electrophoresis, and application.
i. Gel filtration and affinity chromatography: Introduction,technique, applications.

3 **Electrometric Methods:** 12

Theoretical aspects, instrumentation, interpretation of data/spectra and analytical applications be discussed on the following topics.

a. **Potentiometry**: Electrical potential, electrochemical cell, reference electrodes indicator electrodes, measurement of potential and pH, construction and working of electrodes, Potentiometric titrations, methods of detecting end point, Karl Fischer titration.
b. **Conductometry**: Introduction, conductivity cell, conductometric titrations and applications.
c. **Amperometric Titrations:** Introduction, types of electrodes used, reference and indicator electrode, instrumentation, titration procedure, advantages and disadvantages of Amperometry over Potentiometry Pharma applications.

4 **Spectroscopy:** 30

Theoretical aspects, instrumentation, elements of interpretation of data/spectra and application of analytical techniques be discussed on:

a. Absorption Spectroscopy:

Theory of electronic, atomic and molecular spectra.Fundamental laws of photometry, Beer-Lambert's Law,application and its deviation, limitation of Beer law,application of the law to single and multiple componentanalysis, measurement of equilibrium constant and rate constant by spectroscopy. Spectra of isolated chromophores, auxochromes, batho- chromic shift, hypsochromic shift, hyperchromic and hypochromic effect, effect of solvent on absorption spectra, molecular structure and infrared spectra.

Instrumentation – Photometer, U.V.-Visible spectrophotometer – sources of U.V.- Visible radiations, collimating systems, monochro mators, samples cells and following detectors- Photocell,Barrier layer cell, Phototube, Diode array, applications of U.V.-Visible spectroscopy in pharmacy and spectrophotometric titrations.

Infrared Spectroscopy: Vibrational transitions, frequency – structure correlations, Infrared absorption bands, Instrumentation–IR spectrometer – sources of IR, Collimating systems, monochromators, sample cells, sample handling in IR spectroscopy and detectors– Thermocouple, Golay Cells, Thermistor, Bolometer, Pyroelectric detector, Applications of IR in pharmacy.

Fluorimetric Analysis: Theory, luminescence, factors affecting fluorescence, \ quenching. Instrumentation, Applications, fluorescent indicators, study of pharmaceutically important compounds estimated by fluorimetry.

b. **Flame Photometry:** Theory, nebulisation, flame and flame temperature, interferences, flame spectrometric techniques and instrumentation and pharmaceutical applications.
c. **Atomic Absorption Spectrometry:** Introduction, Theory, types of electrodes, instrumentation and applications.
d. **Atomic Emission Spectroscopy**: Spectroscopic sources, atomic emissionspectrometers, photographic andphotoelectric detection.
e. **NMR (introduction only):**Introduction,theoretical aspects and applications
f. **Mass Spectroscopy**: (**Introduction only**) – Fragmentation, types of ionsproduced, mass spectrum and applications.
g. **Polarimetry: (Introduction only**) – Introduction to optical rotatory dispersion, circular dichroism, polarimeter
h. **X-RAY Diffraction: (Introduction only**) – Theory, reciprocal lattice concept, diffraction patterns and applications

22PD32P: PHARMACEUTICAL ANALYSIS (PRACTICAL)

Practical: 3 Hrs./Week **75 Hours**

List of Experiments:

1. Separation and identification of Amino Acids by Paper Chromatography*.
2. Separation and identification of Dyes by radial paper chromatography*.
3. Separation and identification of Sulpha drugs by TLC technique*.
4. Effect of pH and solvent on the UV spectrum of given compound*.
5. Determination of dissociation constant of indicators using UV-Visiblespectroscopy*.
6. Conductometric titration of mixture of acids with a strong base**.
7. Potentiometric titration of strong acid with a strong base**.
8. Estimation of drugs by Fluorimetric technique**.
9. Study of quenching effect in fluorimetry**.
10. Colorimetric estimation of Supha drugs using BMR reagent**.
11. Simultaneous estimation of two drugs present in given formulation**.
12. Assay of Dextrose by colorimetry**
13. Colorimetric estimation of Ferrous ions using 1,10-Phenonthroline**.
14. UV spectroscopic estimation of Paracetamol tablets*
15. Determination of Chlorides and Sulphates in Calcium gluconate byNepheloturbidimetric Method**.
16. Determination of Na/K by Flame Photometry**.
17. Determination of pKa using pH meter*.
18. Infrared spectral graphs/ peak identification of samples with differentfunctional groups (-COOH, -COOR, -NH_2, -NHR, -OH, -CHO, -C=O)
19. Demonstration of HPLC.

SCHEME OF PRACTICAL EXAMINATION:

	Sessional	**Annual**
Synopsis	05	10
Major Experiment (Experiment indicated by**)	10	30
Minor Experiment (Experiment indicated by*)	3	20
Viva-Voce	2	10
Max. Marks	**20**	**70**

Note: Total sessional marks is 30 (20 for practical sessional and 10 marks for regularity,promptness, viva-voce and record maintenance)

22PD33T: PHARMACOTHERAPEUTICS-II (THEORY)

Theory: 3 Hrs. /Week **75 Hours**

Course Outcome

At the end of the course students will be able to...

CO No.	Outcome statement
CO1	Describe the etiopathogenesis of selected disease states
CO2	Discuss the various methods involved in the diagnosis of selected disease states
CO3	Interpret and analyze the selected laboratory results of specific disease states
CO4	Describe the therapeutic approach to manage the selected diseases
CO5	Discuss the rationale for drug therapy of the selected diseases
CO6	Identify the controversies in drug therapy
CO7	Develop the individualized therapeutic plans based on diagnosis
CO8	Identify the patient-specific parameters relevant in initiating the drug therapy

1. **Scope and Objectives:** This course is designed to impart knowledge and skills necessary for contribution to quality use of medicines. Chapters dealt cover brieflypathophysiology and mostly therapeutics of various diseases. This will enable the student to understand the pathophysiology of common diseases and their management.

Upon completion of the course student shall be able to:

1. know the pathophysiology of selected disease states and the rationale fordrugtherapy
2. know the therapeutic approach to management of these diseases
3. know the controversies in drug therapy
4. know the importance of preparation of individualised therapeutic plansbased on diagnosis
5. identify the patient-specific parameters relevant in initiating drug therapy, and monitoring therapy (including alternatives, time-course of clinical and

laboratory indices of therapeutic response and adverse effects)

2. Course Materials: Text books (Theory)

a. Clinical Pharmacy and Therapeutics; 5th.ed. 2012; Walker & Whittlesea,Churchill Livingstone publication

Reference books (Theory)

a) Pharmacotherapy: A Pathophysiology approach - Joseph T. Dipiro etal.10th ed.,2016, Appleton & Lange
b) Clinical Pharmacy and Therapeutics – Eric T. Herfindal, 5th ed. 2016, Williams and Wilkins Publication
c) Applied Therapeutics: The clinical Use of Drugs. Lloyd Young and Koda- Kimble MA, 10th ed. 2013, Wolters Kluwer Lippincot williams &Wilkins,Newyork

3. Lecture wise programme

Etio pathogenesis and pharmacotherapy of diseases associated withfollowing systems / diseases

	Topics	Hrs
1	**Infectious diseases:** Guidelines for the rational use of antibiotics and surgical Prophylaxis, Tuberculosis, Meningitis, Respiratory tract infections, Gastroenteritis,Endocarditis, Septicemia, Urinary tract infections, Protozoal infection- Malaria, HIV & Opportunistic infections, Fungal infections, Viral infections, Gonorrhoea and Syphilis	35
2	**Musculoskeletal disorders** Rheumatoid arthritis, Osteoarthritis, Gout, Spondylitis, Systemic lupus erythematosus.	10
3	**Renal system** Acute Renal Failure, Chronic Renal Failure, Renal Dialysis, Drug induced renal disorders	10
4	**Oncology:** Basic principles of Cancer therapy, General introduction to cancer chemotherapeutic agents, Chemotherapy of breast cancer, leukemia. Managementof chemotherapy induced nausea and emesis	12
5	**Dermatology:** Psoriasis, Scabies, Eczema, Impetigo	08

22PD33P: PHARMACOTHERAPEUTICS-II (PRACTICALS)

Practical : 3 Hrs./Week **75 Hours**

Hospital postings for a period of at least one month is required to understand the principles and practice involved in ward round participation and clinical discussion on selection of drug therapy. Students are required to maintain a recordof 15 cases observed in the ward and the same should be submitted at the end of the course for evaluation.

ASSIGNMENTS

Students are required to submit written assignments on the topics given to them. Topics allotted should cover recent developments in drug therapy of various diseases. A minimum of THREE assignments [1500 – 2000 words] should be submitted for evaluation.

Format of the assignment

- Minimum & Maximum number of pages.
- It shall be computer draft copy
- Reference(s) shall be included at the end.
- Name and signature of the student
- Assignment can be a combined presentation
- Time allocated for presentation may be at the end of the academic year 8+2 min

Scheme of Practical Examination

	Sessional	**Annual**
Synopsis	05	15
Major Experiment	10	25
Minor Experiment	03	15
Viva	02	15
Max Marks	**20**	**70**
Duration	**03 hrs**	**04 hrs**

Note: Total sessional marks is 30 (20 for practical sessional plus 10 marks for regularity,promptness, viva-voce and record maintenance)

22PD34T: PHARMACEUTICAL JURISPRUDENCE (THEORY)

Theory: 2 Hrs. /Week **50 Hours**

Course Outcome

At the end of the course students will be able to...

CO No.	Outcome statement
CO1	Acquire knowledge in practice the Professional ethics
CO2	Understand the various concepts of the pharmaceutical legislation inIndia;
CO3	Learn the knowledge on schedules and functioning of various committees in the Drug and Cosmetic Act and rules
CO4	Understand the labelling requirements and packaging guidelines for drugs and cosmetics
CO5	Understand the Drug policy, DPCO, Patent and Design Act
CO6	Know about narcotic and psychotropic drugs, its productions and drug abuse, its controlling.
CO7	Understand the concepts of Dangerous Drugs Act, Pharmacy Act and Excise Duties Act
CO8	Explain other laws as prescribed by the Pharmacy Council of India from time to time including International Laws

1. **Scope and Objectives**: This course exposes the student to several important legislations related to the profession of pharmacy in India. The Drugs and Cosmetics Act, along with its amendments is the core of this course. Other acts, which are covered, include the Pharmacy Act, dangerous drugs, medicinal and toilet preparation Act etc. Besides this the new drug policy, professional ethics, DPCO, patent and design Act will be discussed.

   Upon completion of the subject student shall be able to (Know, do, and appreciate) –

   1. practice the Professional ethics;
   2. understand the various concepts of the pharmaceutical legislation in India;
   3. know the various parameters in the Drug and Cosmetic Act and rules;
   4. know the Drug policy, DPCO, Patent and design act;
   5. understand the labeling requirements and packaging guidelines for drugs andcosmetics;

6. be able to understand the concepts of Dangerous Drugs Act, Pharmacy Actand Excise duties Act; and
7. Other laws as prescribed by the Pharmacy Council of India from time to timeincluding International Laws.

2. Course materials Text books (Theory)

a. Mithal, B M. Textbook of Forensic Pharmacy. Calcutta: National; 10th ed.2014, vallabha Prakashan, Newdelhi.

Reference books (Theory)

a. Singh, KK, editor. Beotra's the Laws of Drugs, Medicines & cosmetics.Allahabad: Law Book House; 1984.
b. Jain, NK. A Textbook of forensic pharmacy. 8th ed. 2015, Delhi: VallabhPrakashan;
c. Reports of the Pharmaceutical enquiry Committee d. I.D.M.A., Mumbai. DPCO 1995
d. Various reports of Amendments.
e. Deshapande, S.W. The drugs and magic remedies act 1954 and rules 1955.Mumbai: Susmit Publications; 1998.
f. Eastern Book Company .The narcotic and psychotropic substances act 1985,Lucknow: Eastern; 1987.

3. Lecture wise programme:

	Topics	Hrs
1	**Pharmaceutical Legislations – A brief review.** Introduction, Study of drugs enquiry committee, Health survey and development committee, Hathi committee andMudaliar committee	02
2	**Code of Pharmaceutical Ethics** Definition, Pharmacist in relation to his job, trade, medical profession and his profession, Pharmacist's oath	02
3	**Drugs and Cosmetics Act, 1940 and its rules 1945.** Objectives, Definitions, Legal definitions of schedules to the act and rules Import of drugs – Classes of drugs and cosmetics prohibited from import, Import under license or permit. Offences and penalties. Manufacture of drugs – Prohibition of manufacture and sale of certain drugs, Conditions for grant of license and conditions of license	22

	for manufacture of drugs, Manufacture of drugs for test, examination and analysis, manufacture of new drug, loanlicense and repacking license. Detailed study of scheduleM, N and Y. Offences and penalties. Sale of Drugs – Wholesale, Retail sale and Restrictedlicense. Offences and penalties. Labeling & Packing of drugs - General labeling requirements and specimen labels for drugs and cosmetics,List of permitted colors. Offences and penalties Administration of the act and rules – Drugs Technical Advisory Board, Central drugs Laboratory, Drugs Consultative Committee, Government analysts, Licensing authorities, controlling authorities, Drug Inspectors	
4	**Pharmacy Act –1948.** Objectives, Definitions, Pharmacy Council of India; its constitution and functions, Education Regulations, Stateand Joint state pharmacy councils; its constitution and functions, Registration of Pharmacists, Offences and Penalties.	05
5	**Medicinal and Toilet Preparation Act –1955.** Objectives, Definitions, Licensing, Manufacture in bond and Outside bond, Export of alcoholic preparations, Manufacture of Ayurvedic, Homeopathic, Patent & Proprietory Preparations. Offences and Penalties.	04
6	**Narcotic Drugs and Psychotropic substances Act-1985 and Rules.** Objectives, Definitions, Authorities and Officers, Constitution and Functions of narcotic & Psychotropic Consultative Committee, National Fund for Controlling the Drug Abuse, Prohibition, Control and Regulation, opium poppy cultivation and production of poppy straw,manufacture, sale and export of opium, Offences and Penalties	04
7	**Study of Salient Features of Drugs and magic remedies Act and its rules.** Objectives, Definitions, Prohibition of certain advertisements, Classes of Exempted advertisements, Offences and Penalties	02
8	**Drug Price Control Order & National Drug Policy (Current).** Objectives, Definitions, Sale prices of bulk drugs, Retailprice of formulations, Retail price and ceiling price of	02

	scheduled formulations, Implementation of prices Fixed/ revised. **Pharmaceutical Policy 2002:** Objectives, Approaches inthe review, Salient features of Pharmaceutical Policy 2002.	
9	**Prevention of Cruelty to animals Act-1960.** Objectives, Definitions, Institutional Animal Ethics Committee, Breeding and Stocking of Animals, Performance of Experiments, Transfer and acquisition ofanimals for experiment, Records, Power to suspend or revoke registration, Offences and Penalties	03
10	**Patents & design Act-1970.** - Objectives, definitions, Types of patent, PCT, Patentable and not patentable inventions, Applications for patents, Term of patent, revocation of patents, compulsory licensing, Offences and penalties. - Registration of designs, copyright, prohibition of certain designs, cancellation of designs, Offences and penalties.	03
11	**Brief study of prescription and Non-prescription Products.**	01

Assignments:

Format of the assignment

1. Minimum & Maximum number of pages
2. It shall be a computer draft copy
3. Reference(s) shall be included at the end.
4. Name and signature of the student
5. Assignment can be a combined presentation at the end of the academic year.
6. Time allocated for presentation may be 8+2 Min

Case studies relating to

1. Drugs and Cosmetics Act and rules along with its amendments, Dangerous Drugs Act, Medicinal and Toilet preparation Act, New Drug Policy, Professional Ethics, Drugs (Price control) Order, Patent and Design Act.
2. Various prescription and non-prescription products.
3. Medical and surgical accessories.
4. Diagnostic aids and appliances available in the market.

22PD35T: MEDICINAL CHEMISTRY (THEORY)

Theory: 3 Hrs. /Week **75 Hours**

Course Outcome

At the end of the course students will be able to...

CO No.	Outcome statement
CO1	Explain various Modern techniques of design and development which include CADD Studies
CO2	Describe the detailed Prodrug concept combinatorial Chemistry aspects.
CO3	Outline the Chemistry and explain physicochemical properties of the drugs
CO4	Describe the brief SAR of the drugs with respect to their biological activity
CO5	Explain the Mechanism of action, metabolism, adverse effects and uses of anti-infectives, antibiotics, Chemotherapeutic Agents, Cardiovascular Drugs, hypoglycemisc agents, antithyroid agents, diuretics, steroids
CO6	Explain various synthetic routes of some important drugs.
CO7	Describe the Medicinal Compounds and their Importance in diagnostics purpose
CO8	Describe various drugs belong to the Class of steroids and steroidal hormones

1. **Scope and Objectives**: This course is designed to impart a fundamental knowledge on the structure and functions of the different drugs. The course gives details of Chemistry, Mechanism of action, metabolism, adverse effects, Structure Activity Relationships (SAR) and uses of Chemotherapeutic Agents, Cardiovascular Drugs and synthesis of some important drugs. The course also covers modern techniques of drug design, which include Prodrug concept and combinatorial chemistry.

   At the end of the course, students are able

   1. To understand the chemistry of drugs with respect to their biologicalactivity.
   2. To know the metabolism, adverse effect and therapeutic activity of drugs.

3. To understand the different modern techniques of drug design.
4. To appreciate the SAR of some important drug classes.

2. Course materials:

Text books

a. Wilson and Giswolds, Text book of Organic and pharmaceutical chemistry, 12th 2015, Wolter Kluwer
b. Principles of Medicinal chemistry- William O. Foye, 7th ed. 2012,wolterkluwer,

Reference books

a. A I Vogel Text book of Practical Organic Chemistry, 5th ed, Pearson
b. Text Book of organic chemistry by I. L. Finar, 6th ed. 2014,Pearson.
c. A text book of Inorganic medicinal Chemistry by Surendra N. Pandey.2011, K.G. Publisher, Varanasi

3. Lecture wise Programme:

	Topics	**Hrs**
1	I. Modern concept of rational drug design: A brief introduction to Quantitative Structure Activity Relationaship (QSAR), prodrug, combinatorial chemistry and computer aided drug design (CADD) and concept of antisense molecules. II. A study of the development of the following classes of drugs including SAR, mechanism of action, synthesis of important compounds, chemical nomenclature, brand names of important marketed products and their side effects. **Anti-infective agents:** Local anti-infective agents: Alcohols: isopropyl alcohol Phenols: cresols, hexyl resorcinol Oxidizing agents: Hydrogen peroxide solution,hydrous benzoyl peroxide. Halogen containing compounds: Iodine TinctureDyes- Gentian Violet, Methylene blue. Cationic surfactants: benzalkonium chloride, cetylpyridinium bromide Nitrofurans: nitrofurazone, furazolidone.	06 15

Preservatives:

a. Methylparaben, Propylparaben, Ethyl paraben, Chlorobutanol, Benzyl alcohol, Phenylethyl alcohol, Sodium benzoate, Phenyl mercuric nitrate, Phenyl mercuric acetate.
b. Antifungal agents:
   Azoles: miconazole, ketoconazole, fluconazole,clotrimazole.
   Miscellaneous: tolnaftate*, naftifine
   Antifungal Antibiotics: amphotericin, nystatin, griseofulvin.
c. Urinary tract anti-infectives:
   SAR of quinolone antibacterial agents, Norfloxacin, ciprofloxacin*, sparfloxacin,ofloxacin, nitrofurantoin*.
d. Antitubercular agents: Management of tuberculosis,Synthetic anti TB agents: PAS*, INH*, Pyrizinamide, ethambutol, Anti TB antibiotics: rifampin, capreomycin
e. Antiviral agents and Anti AIDS agents: amantadine, acyclovir, iodoxuridine, trifluridine, zidovudine, stavudine
f. Antiprotozoal agents: Introduction to protozoal diseases and causative organisms. Metronidazole*, diloxanide furoate*,dehydroemetine, nifurtimox
g. Anthelmentics: Benzimidazoles: mebendazole, albendazole Piperazine, diethylcarbamazine*,ivermectin

2 **Sulfonamides and sulfones** 04

History and development of sulfonamides, SAR and mechanism of action of Sulfonamides, pKa of Sulfas and Crystalluria. Sulfamethoxazole*, sulfisoxazole, sulfacetamide*, sulfasalzine Folate reductase inhibitors: trimethoprim*, synergistic action of cotrimoxazole. Sulfones: dapsone*

3 **Antimalarials:** 05

Etiology of malaria, SAR and mechanism of action of quinolone Antimalarials Quinine sulphate, Chloroquine phosphate, amodiaquine, pamaquine*, primaquine, Quinacrine Chloroguanide,cycloguanil, pyrimethamine*

4	**Antibiotics** Historical background and classification of antibiotics. Beta lactam antibiotics: development of acid resistant and extended spectrum Penicillins. Penicillin G, ampicillin, amoxicillin, cloxacillin Beta lactamase inhibitors: clavulanic acid, thienamycin Cephalosporins: cephelexin, cefadroxil, cefuroxime Aminoglycosids: streptomycin, neomycin,amikacin, gentamicin Tetracyclines: Chemistry and SAR of tetracyclines, chlortetracycline, doxycycline, Minocycline. Macrolides: erythromycin, azithromycin Miscellaneous: clindamycin, bacitracin,chloramphenicol*	12
5	**Antineoplastic agents** Historical background and classification of antineoplastic agents Alkylating agents: cyclophosphamide*, mechlorethamine, cholrambucil* Antimetabolites: mercaptopurine, flurouracil, methotrexate Antibiotics: dactinomycin, mitomycin, streptozocin Plant products: etoposide, taxol, vincristine and vinblastine Miscellaneous: cisplatin, interferons	06
6	Cardiovascular agents a) Antianginal agents and vasodilators Nitrovasodilators: amyl nitrite, isosorbide dinitrateCalcium channelblockers: verapamil, diltiazem b) Antiarrhythmic agents: Class I: quinidine, phenytoin*, lidocaine, encainideClass II: beta blockers- propranolol Class III: amiodarone Class IV: Calcium channel blockers: verapamil*, diltiazem c) Antihypertensive agents:betablockers: propranolol*, ACE inhibitors: captopril, enalaprilAngiotensin antagonists: losartan	12

	Calcium channel blockers: nifedipine, amlodepine Adrenergic agents: clonidine, methyl dopa Adrenergic antagonists: prazosin, reserpine d) Antihyperlipidemic agents: types of hyperlipoproteinemia clofibrate*, fenofibrate, cholestyramine, lovastatin, simvastatin e) Anticoagulants: warfarin*, dicumarol*, anisindione	
7	**Hypoglycemic agents:** History, development and SAR of sulfonylureas: tolbutamide*, chlorpropamide*, glipizide Metaglinides: repaglinide Thiazolindiones: rosiglitazone, pioglitazoneBiguanides: metformin, phenformin Miscellaneous: acarabose, miglitol	03
8	**Thyroid and Antithyroid agents** L-thyroxine, L-threonine Propyl thiouracil, methimazole	01
9	**Diuretics:** Carbonic anhydrase inhibitors: acetazolmide* Thiazide diuretics: SAR of thiazide diuretics, chlorthiazide, benzthiazide, xipamide, chlorthalidone Loop diuretics: frusemide*, ethacrynic acid*Potassium sparing diuretics: spiranolactone, amiloride Miscellaneous: mannitol	05
10	**Diagnostic agents** Iodipamide, diatriazoate sodium Amino hippurate,sulfobromphthalein, fluorescein sodium	01
11	**Steroidal Hormones and Adrenocorticoids** Estrogens: estradiol, DES Progestines: progesterone, norethindroneTestosterone, nandralone Betamethasone, prednisolone, beclomethasone	05

22PD35P: MEDICINAL CHEMISTRY (PRACTICAL)

Practical: 3 Hrs./Week **75Hours**

List of experiments

A. Assays of important drugs from the course content.

1. Assay of ascorbic acid by cerimetry
2. Assay of metronidazole by NAT
3. Assay of chloroquine phosphate by NAT
4. Assay of dapsone by diazotization
5. Assay of INH by bromometry
6. Assay of benzyl penicillin by iodometry
7. Assay of analgin by iodimetry
8. Assay of diclofenac by alkalimetry

B. Preparation of medicinally important compounds or intermediates required for synthesis of drugs

1. Preparation of 7-hydroxy 4-methyl coumarin
2. Preparation of phenytoin from benzoin
3. Preparation of phenothiazine from diphenyl amine
4. Preparation of benzyl alcohol from benzaldehyde
5. Preparation of chlorbutanol
6. Preparation of eosin from resorcinol
7. Preparation of fluorescein from eosin
8. Preparation of triphenyl imidazole from benzoin
9. Preparation of 2,3 diphenyl quinoxaline from OPDA
10. Preparation of benztriazole from OPDA
11. Preparation of benzimidazoles from OPDA
12. Preparation of sulfanilamide from acetanilide
13. Preparation of INH
14. Preparation of cinnamic acid

C. Monograph analysis of important drugs.

1. Monograph analysis of ibuprofen
2. Monograph analysis of aspirin
3. Monograph analysis of caffeine
4. Monograph analysis of sulfanilamide
5. Monograph analysis of paracetamol

D. Determination of partition coefficients, dissociation constants of drug substances.

Scheme of Practical Examination

	Sessionals	**Annual**
Synopsis	04	10
Assay/Estimation	06	30
Preparation	06	20
Viva	04	10
Max Marks	20	70
Duration	**03 hrs**	**04 hrs**

Note: Total sessional marks is 30 (20 for practical sessional plus 10 marks for regularity,promptness, viva-voce and record maintenance)

22PD36T: PHARMACEUTICAL FORMULATIONS (THEORY)

Theory: 2 Hrs. /Week **50 Hours**

Course Outcome

At the end of the course students will be able to...

CO No.	Outcome statement
CO1	Know the types of tablets & granulation techniques.
CO2	Learn the quality control test and evaluation of uncoated as well as coated tablets.
CO3	Learn production and filling of hard & soft gelatine capsules. Quality control test for Same
CO4	Explain the formulation and evaluation of semisolid preparation such as ointment, gel etc.
CO5	Learn the formulation concepts ofpharmaceutical suspensions and emulsions and their stability problems
CO6	Acquire working knowledge and understanding the production facilities of Parenterals
CO7	Understand pharmacopoeial quality control tests, as well as Container-closure systems for injections
CO8	Know the various controlled and novel drug delivery systems and its importance

1. **Scope and Objective:** Scope and objectives of the course:
   Subject deals with the formulation and evaluation of various pharmaceuticaldosage forms.

   Upon completion of the course student shall be able to (Know, do,appreciate):

   1. understand the principle involved in formulation of various pharmaceutical dosage forms;
   2. prepare various pharmaceutical formulation;
   3. perform evaluation of pharmaceutical dosage forms; and
   4. understand and appreciate the concept of bioavailability and bioequivalence, their role in clinicalsituations.

2. Coursematerial

Text books

a) Pharmaceutical dosage forms, Vol, I, II and III by Liberman & Lachman, 1989, Marcel Dekker, Newyork
b) Rowlings Text book of Pharmaceutics , Rawlins E.A , 8th. Ed. 2010Elsevier Saunders, Philedelphia
c) Tutorial Pharmacy – Cooper & Gun, 6th 1986, poplur Prakashan,

Reference books

a) Remington's Pharmaceutical Sciences, Vol. 1-3, 22nd ed.2010.WolterKluwer and Lippincott,
b) USP, The United States Pharmacopoeia, 36th 2018, ed.Vol.1-3,supp1-2, Govt. of India, Ministry of Health
c) MHRA, British Pharmacopoeia – 2017,Vol. 1-5+Vet, Govt. of India, Ministry of Health
d) Indian Pharmacopoeia 2018, 8th Edition (4 Volumes) . Govt. ofIndia, Ministry of Health

3. Lecture wise programme:

	Topics	Hrs
1	**Tablets**: Formulation of different types of tablets, tablet excipients, granulation techniques, Tablet coating, Type of coating, quality control tests and evaluation for uncoated andcoated tablets.	10
2	**Capsules:** Production and filling of hard gelatin capsules, Raw materials for shell, finishing. Production and filling of soft gelatin capsules, Importance of base adsorption, quality controltests for hard and soft gelatin capsules.	07
3	**Liquid orals**: Formulation, Manufacturing and evaluation of suspensions, emulsions and solutions. Instability problems in suspensions and emulsions.	06
4	**Parenterals**: Definition, types, advantages and limitation, general formulation, vehicles, production procedure, production facilities, and controls. Formulation of injections, sterile powders, implants and long acting parenterals, emulsions and suspensions. Containers and closures pertinentto sterile preparations and Pharmacopoeial quality control tests, Sterilization and evaluation.	13

5	**Semi – Solids**: Introduction and classification Factors affecting absorption, Packaging, storage and labeling. Ointments: Types of Ointment Base Preparation of ointment. Gels: Types andformulation of Gels	06
6	**Definition and concept of Controlled and novel Drug delivery systems** with available examples, viz. transdermal, buccal, vaginal, nasal, implantable, ocular drug deliverysystems	08

22PD36P: PHARMACEUTICAL FORMULATIONS (PRACTICAL)

Practical: 3 Hrs./Week **75 Hours**

List of Experiments:

1. **Manufacture of Tablets**
   a. Ordinary compressed tablet-wet granulation
   b. Tablets prepared by direct compression.
   c. Soluble tablet.
   d. Chewable tablet.
2. **Formulation and filling of hard gelatin capsules**
3. **Manufacture of parenterals**
   a. Ascorbic acid injection
   b. Calcium gluconate injection
   c. Sodium chloride infusion.
   d. Dextrose and Sodium chloride injection/ infusion.
4. **Evaluation of Pharmaceutical formulations (QC tests)**
   a. Tablets
   b. Capsules
   c. Injections
5. **Formulation of two liquid oral preparations and evaluation by assay**
   a. Solution: Paracetamol Syrup
   b. Antacid suspensions- Aluminum hydroxide gel
6. **Formulation of semisolids and evaluation by assay**
   a. Salicyclic acid and benzoic acid ointment
   b. Gel formulation Diclofenac gel
7. **Cosmetic preparations**
   a. Lipsticks
   b. Cold cream and vanishing cream
   c. Clear liquid shampoo
   d. Tooth paste and tooth powders.
8. **Tablet coating (demonstration)**

Scheme of Practical Examination:

	Sessionals	**Annual**
Synopsis	05	15
Major Experiment	10	25
Minor Experiment	03	15
Viva	02	15
Max Marks	**20**	**70**
Duration	**03 hrs**	**04 hrs**

Note : Total sessional marks is 30 (20 for practical sessional plus 10 marks for regularity,promptness, viva-voce and record maintenance).

22PD41T: PHARMACOTHERAPEUTICS – III (THEORY)

Theory: 3 Hrs. /Week **75 Hours**

Course Outcome

At the end of the course students will be able to...

CO No.	Outcome statement
CO1	Describe the Etiopathogenesis of selected disease states
CO2	Discuss the various methods involved in the diagnosis of selected disease state
CO3	Interpret and analyze the selected laboratory results of specific disease states
CO4	Describe the therapeutic approach to manage the selected diseases
CO5	Discuss the rationale for drug therapy of the selected disease
CO6	Identify the controversies in drug therapy
CO7	Develop the individualized therapeutic plans based on diagnosis
CO8	Identify the patient-specific parameters relevant in initiating the drug therapy
CO9	Describe evidence based medicine

1. **Scope and Objectives:** This course is designed to impart knowledge and skills necessary for contribution to quality use of medicines. Chapters dealt cover briefly pathophysiology and mostly therapeutics of various diseases. This will enable the student to understand the pathophysiology of common diseases and their management.
   At completion of this course it is expected that students will be able to understand:
   1. The pathophysiology of selected disease states and the rationale for drugtherapy
   2. The therapeutic approach to management of these diseases
   3. The importance of preparation of individualised therapeutic plansbased on diagnosis
   4. Needs to identify the patient-specific parameters relevant in initiating drug therapy, and monitoring therapy (including alternatives, time- course of clinical and laboratory indices of therapeutic response and

adverse effects)

5. Describe the pathophysiology of selected disease states and explain therationale for drug therapy
6. Summarize the therapeutic approach to management of these diseasesincluding reference to the latest available evidence
7. Discuss the controversies in drug therapy
8. Discuss the preparation of individualised therapeutic plans based on diagnosis
9. Identify the patient-specific parameters relevant in initiating drug therapy, and monitoring therapy (including alternatives, time- course of clinical and laboratory indices of therapeutic response and adverse effects)

2. Course Materials:

Text Books

a) Clinical Pharmacy and Therapeutics; 5th.ed. 2012; Walker & Whittlesea, Churchill Livingstone publication
b) Pharmacotherapy: A Pathophysiology approach - Joseph T. Dipiro etal.10th ed.,2016, Appleton & Lange

Reference Books

a) Pathologic basis of disease by- Cotran, Kumar, Robbins Elsiver India Pvt Ltd, Newdelhi, 2015, ed. 9 vol. 1-2
b) Pathology and Therapeutics for Pharmacists - A Basis for Clinical Pharmacy Practice - Green and Harris, 3rd. ed.,Chapman and Hall publication
c) Clinical Pharmacy and Therapeutics - Eric T. Herfindal, 5th ed. 2016, Williams and Wilkins Publication
d) Applied Therapeutics: The clinical Use of Drugs. Lloyd Young and Koda- Kimble MA, 10th ed. 2013, Wolters Kluwer Lippincot williams & Wilkins, Newyork
e) Avery's Drug Treatment - 4th Ed., 1997, Adis International Limited.
f) Relevant review articles from recent medical and pharmaceutical literature.

3. Lecture wise Programme

Etiopathogenesis and pharmacotherapy of diseases associated withfollowing systems/ diseases

	Topics	Hrs
1	**Gastrointestinal system:** Peptic ulcer disease, Gastro Esophageal Reflux Disease, Inflammatory bowel disease, Liver disorders – Alcoholic liver disease, Viral hepatitis including jaundice, and Druginduced liver disorders.	20
2	**Haematological system:** Anaemias, Venous thromboembolism, Drug induced blood disorders.	12
3	**Nervous system:** Epilepsy, Parkinsonism, Stroke, Alzheimer's disease	16
4	**Psychiatry disorders:** Schizophrenia, Affective disorders, Anxiety disorders, Sleep disorders,Obsessive Compulsive disorders	14
5	Pain management including Pain pathways, neuralgias, headaches	08
6	**Evidence Based Medicine**	05

22PD41P: PHARMACOTHERAPEUTICS – III (PRACTICAL)

Practical: 3 Hrs./Week **75 Hours**

Practicals:

Hospital postings for a period of at least 50 hours is required to understand the principles and practice involved in ward round participation and clinical discussion on selection of drug therapy. Students are required to maintain a record of 15 cases observed in the ward and the same should be submitted at the end of the course for evaluation. Each student should present at least two medical cases they have observed and followed in the wards.

Assignments:

Students are required to submit written assignments on the topics given to them. Topics allotted should cover recent developments in drug therapy of various diseases. A minimum of THREE assignments [1500 – 2000 words] should be submitted for evaluation.

Format of the assignment:

1. Minimum & Maximum number of pages
2. Reference(s) shall be included at the end.
3. Assignment can be a combined presentation at the end of academic year
4. It shall be computer draft copy
5. Name and signature of the student
6. Time allocated for presentation may be 8+2 Min.

Scheme of Practical Examination:

	Sessionals	**Annual**
Synopsis	05	15
Major Experiment	10	25
Minor Experiment	03	15
Viva	02	15
Max Marks	**20**	**70**
Duration	**03 hrs**	**04 hrs**

Note : Total sessional marks is 30 (20 for practical sessional plus 10 marks for regularity, promptness, viva-voce and record maintenance).

22PD42T: HOSPITAL PHARMACY (THEORY)

Theory: 2 Hrs. /Week **50 Hours**

Course Outcome

At the end of the course students will be able to...

CO No.	Outcome statement
CO1	Describe the organizational structure of hospital & hospital pharmacy
CO2	Explain different drug policies & committees in the hospital
CO3	Operate various drug distribution methods in the hospital
CO4	Describe the management of inventory control in the hospital pharmacy
CO5	Explain the continuing professional development programs in hospitals
CO6	Understand the manufacturing practices of various formulations in hospital set up
CO7	Explain the professional relations and practices of hospital pharmacist
CO8	Describe the procedure for procuring & warehousing of drugs & pharmaceuticals

1. **Scope and Objectives**: In the changing scenario of pharmacy practice in India, for successful practice of Hospital Pharmacy, the students are required to learn various skills like drug distribution, drug dispensing, manufacturing of parenteral preparations, drug information, patient counseling, and therapeutic drug monitoring for improved patient care.

   Upon completion of the course, the student shall be able to :

   1. Know various drug distribution methods;
   2. Know the professional practice management skills in hospital pharmacies;
   3. Provide unbiased drug information to the doctors;
   4. Know the manufacturing practices of various formulations in hospital set up;
   5. Appreciate the practice based research methods; and
   6. Appreciate the stores management and inventory control.

2. Course materials:

Text books: (latest editions)

a) Hospital pharmacy by William .E. Hassan, 5th ed. 1990, K.M.Varghese,Mumbai.

b) A text book of Hospital Pharmacy by S.H.Merchant & Dr.J.S.Qadry.Revised by R.K.Goyal & R.K. Parikh

References:

a) WHO consultative group report.

b) R.P.S. Vol.2. Part –B; Pharmacy Practice section.

c) Handbook of pharmacy – health care. Ed. Robin J Harman. The Pharmaceutical press.

3. Lecture wise programme:

	Topics	**Hrs**
1	**Hospital - its Organisation and functions**	01
2	**Hospital pharmacy-Organisation and management**	04
	a) Organizational structure-Staff, Infrastructure & workload statistics	
	b) Management of materials and finance	
	c) Roles & responsibilities of hospital pharmacist	
3	**The Budget – Preparation and implementation**	01
4	**Hospital drug policy**	10
	a) Pharmacy and Therapeutic Committee (PTC)	
	b) Hospital formulary	
	c) Hospital committees	
	- Infection committee	
	- Research and ethical committee	
	d) Development of therapeutic guidelines	
	e) Hospital pharmacy communication – Newsletter	
5	**Hospital pharmacy services**	10
	a)Procurement & warehousing of drugs and Pharmaceuticals	
	b) Inventory control**:** Definition, various methods of Inventory Control ABC, VED, EOQ, Lead time and safety stock	
	c) Drug distribution in the hospital	
	i) Individual prescription method	
	ii) Floor stock method	
	iii) Unit dose drug distribution method	

	d) Distribution of Narcotic and other controlled substances e) Central sterile supply services – Role of pharmacist	
6	**Manufacture of Pharmaceutical preparations** a) Sterile formulations – large and small volumeparenterals b) Manufacture of Ointments, Liquids, and creams c) Manufacturing of Tablets, granules, capsules, andpowders d) Total parenteral nutrition	10
7	**Continuing professional development programs** Education and training	03
8	**Radio Pharmaceuticals – Handling and packaging**	02
9	**Professional Relations and practices of hospital pharmacist**	02

22PD42P: HOSPITAL PHARMACY (PRACTICAL)

Practical: 3 Hrs. /Week **75 Hours**

1. Assessment of drug interactions in the given prescriptions
2. Manufacture of parenteral formulations and powders.
3. Drug information queries.
4. Inventory control

List of Assignments:

1. Design and Management of Hospital pharmacy department for a 300 beddedhospital.
2. Pharmacy and Therapeutics committee – Organization, functions, andlimitations.
3. Development of a hospital formulary for 300 bedded teaching hospital
4. Preparation of ABC analysis of drugs sold in one month from the pharmacy.
5. Different phases of clinical trials with elements to be evaluated.
6. Various sources of drug information and systematic approach to provideunbiased drug information.
7. Evaluation of prescriptions generated in hospital for drug interactions andfind out the suitable management.

Special requirements:

1. Each college should sign MoU with nearby local hospital having minimum 150 beds for providing necessary training to the students' on hospital pharmacyactivities.
2. Well equipped with various resources of drug information.

Scheme of Practical Examination:

	Sessionals	**Annual**
Synopsis	05	15
Major Experiment	10	25
Minor Experiment	03	15
Viva	02	15
Max Marks	**20**	**70**
Duration	**03 hrs**	**04 hrs**

Note : Total sessional marks is 30 (20 for practical sessional plus 10 marks for regularity,promptness, viva-voce and record maintenance).

22PD43T: CLINICAL PHARMACY (THEORY)

Theory: 3 Hrs. /Week **75 Hours**

Course Outcome

At the end of the course students will be able to...

CO No.	Outcome statement
CO1	Describe development and scope of clinical pharmacy
CO2	Discuss various services provided by clinical pharmacist in a hospital
CO3	Assess the drug therapy of patient through medication chart review and clinical review
CO4	Interpret and analyze clinical laboratory test results of specific diseases
CO5	Discuss the Organization and functions of Drug & Poison information and centers
CO6	Discuss the importance of drug safety monitoring and the development of pharmacovigilance program
CO7	Identification and management of Adverse Drug Reactions
CO8	Discuss critical evaluation of biomedical literature
CO9	Explain communication skills required for clinical pharmacy services provision

1. **Scope and Objectives:** This course is designed to impart the basic knowledge and skills that required for practice of pharmacy including provision of various clinical pharmacy services to patients and healthcare professionals in clinical settings.

   Upon completion of the course, student shall be able to

   1. Monitor drug therapy and resolve drug related problems
   2. Counsel the patients for safe and effective use of medications
   3. Assist healthcare professionals in detecting and managing medicationerrors including ADR
   4. Provide unbiased drug and poison information services
   5. Interpret, analyze and correlate the lab investigations

2. Course Materials Text books (Theory)

a. Practice Standards and Definitions, the Society of Hospital Pharmacistsof Australia.
b. Basic skills in interpreting laboratory data, Scott LT, 2nd. Ed. 1996, American Society of Health System Pharmacists Inc.
c. Biopharmaceutics and Applied Pharmacokinetics, Leon Shargel, 6th ed.2013, Prentice Hall Publication
d. Textbook of Clinical Pharmacy Practice; Essential concepts and skills, Dr. G. Parthasarathi, Karin Nyfort-Hansen, Milap Nahata, 2nd ed. 2015,Orient Longman Pvt. Ltd.

Reference Books

a. Australian drug information -Procedure manual. The Society of Hospital Pharmacists of Australia.
b. Cilincal Pharmacokinetics, Concepts and Applications: By Malcolm Rowland and Thomas, N. Tozen, Lea and Febrger, Philadelphia, 4th ed.2010.
c. Pharmaceutical statistics. Practical and clinical applications.4th ed. 2003, Sanford Bolton, Marcel Dekker, Inc

3. Lecture wise programme

	Topics	Hrs
1	**Definitions, development and scope of clinical pharmacy**	03
2	**Introduction to daily activities of a clinical pharmacist** a. Drug therapy monitoring (medication chart review, clinicalreview, pharmacist interventions) b. Ward round participation c. Adverse drug reaction management d. Drug information and poisons information e. Medicationhistory e. Patient counselling f. Drug utilisation evaluation (DUE) and review (DUR) g. Quality assurance of clinical pharmacy services	13
3	**Patient data analysis** • The patient's case history, its structure and use in evaluation of drug therapy & understanding common medical abbreviations and terminologies used in clinical practices	03

4	**Clinical laboratory tests used in the evaluation of disease states, and interpretation of test results** • Haematological, Liver function, Renal function, thyroidfunction tests • Tests associated with cardiac disorders • Fluid and electrolyte balance • Microbiological culture sensitivity tests • Pulmonary Function Tests	15
5	**Drug & Poison information** • Introduction to drug information resources available • Systematic approach in answering DI queries • Critical evaluation of drug information and literature • Preparation of written and verbal reports • Establishing a Drug Information Centre • Poisons information- organization & information resources	08
6	**Pharmacovigilance** Scope, definition and aims of pharmacovigilance • Adverse drug reactions - Classification, mechanism, predisposing factors, causality assessment [different scalesused], • Reporting, evaluation, monitoring, preventing &management of ADRs • Role of pharmacist in management of ADR.	10
7	Communication skills, including patient counseling techniques, medication history interview, presentation of cases.	10
8	Pharmaceutical care concepts	04
9	Critical evaluation of biomedical literature	06
10	Medication errors	03

22PD43P: CLINICAL PHARMACY (PRACTICALS)

Practical: 3 Hrs. /Week **75 Hours**

Students are expected to perform 15 practical in the following areas covering thetopics dealt in theory class.

Answering drug information questions (4 Nos) Patient medicationcounseling (4 Nos)
Case studies related to laboratory investigations (4 Nos)Patient medication history interview (3 Nos)

ASSIGNMENT

Students are expected to submit THREE written assignments (1500 – 2000 words) on the topics given to them covering the following areas dealt in theoryclass.

Drug information, Patient medication history interview, Patient medication counseling, Problem solving in Clinical Pharmacokinetics, Therapeutic drug monitoring and Critical appraisal of recently published articles in the biomedical literature which deals with a drug or therapeutic issue.

Format of the assignment

- Minimum & Maximum number of pages.
- It shall be computer draft copy
- Reference(s) shall be included at the end.
- Name and signature of the student
- Assignment can be a combined presentation
- Time allocated for presentation at the end of the academic year may be 8+2min

22PD44T: BIOSTATISTICS AND RESEARCH METHODOLOGY (THEORY)

Theory: 2 Hrs. /Week **50 Hours**

1. **Scope and Objective:** This is an introductory course in statistics, research methodology and Computer application in hospital and community Pharmacy. This subject deals with Research methodology, Biostatics, epidemiologyand Computer application and clinical studies. Research methodology deal about types of clinical study, designing, sample size determination and power of study Statistics deals about frequency distribution, graphics, averages, measures of dispersion, Correlation, regression, Parametric and non-parametric tests. Incidence and prevalence, relative risk, attributable risk

   Computer Application deals with application of Computer System in Hospital Pharmacy and Community Pharmacy

   Upon completion of the course the student shall be able to:

   1. Know the various statistical methods to solve different types of problems
   2. Operate various statistical software packages
   3. Appreciate the importance of Computer in hospital and Community Pharmacy
   4. Appreciate the statistical technique in solving the pharmaceutical problems

2. **Course material:**

   Reference books:

   a) Pharmaceutical statistics. Practical and clinical applications.4th ed. 2003, Sanford Bolton, Marcel Dekker, Inc.

   b) Drug Information- A Guide for Pharmacists, Patrick M Malone, Karen L Kier, John E Stanovich , 5rd edition, McGraw Hill Publications 2014

   c) Computer Application in Pharmacy – William E. Fassett, publisher – Lea & Febiger. Philadelphia

3. Lecture wise Programme

	Topics	Hrs
1	**Research Methodology** a)Types of clinical study designs: Case studies, observational studies, interventional studies, b) Designing the methodology c)Sample size determination and Power of a study, Determination of sample size for simple comparative experiments, determination of sample size to obtain a confidence interval of specified width, power of a study d) Report writing and presentation of data	10
2	2.1 **Biostatistics** a) Introduction b) Types of data distribution c)Measures describing the central tendency distributions- average, median, mode d) Measurement of the spread of data-range, mean deviation, standard deviation, variance, coefficient ofvariation, standard error of mean.	10
	2.2 **Data graphics** : Construction and labeling of graphs, histogram, Pie charts, scatter plots, semi-logarithmic graphs	02
	2.3 **Basics of testing hypothesis** : a) Null hypothesis, level of significance, power of test, P value, statistical estimation of confidenceintervals. b) Level of significance (Parametric data)- students t test (paired and unpaired), chi Square test, Analysisof Variance (one-way and twoway) c) Level of significance (Non-parametric data)- Sign test, Wilcoxan's signed rank test, Wilcoxan rank sum test, Mann Whitney U test, Kruskal-Wall's test(one way ANOVA) d) Linear regression and correlation- Introduction,Pearson's and Spearman's correlation and correlation co-efficient. e) Introduction to statistical software: SPSS, Epi Info,SAS.	15
	2.4 **Statistical methods in epidemiology** Incidence and prevalence, relative risk, attributable risk	05

3	**Computer applications in pharmacy** **Computer System in Hospital Pharmacy**: Patterns of Computer use in Hospital Pharmacy – Patient record database management, Medication orderentry – Drug labels and list – Intravenous solution and admixture, patient medication profiles, Inventory control, Management report & Statistics. **Computer In Community Pharmacy** Computerizing the Prescription Dispensing process Use of Computers for Pharmaceutical Care in community pharmacy Accounting and General ledgersystem **Drug Information Retrieval & Storage :** Introduction – Advantages of Computerized LiteratureRetrieval, Use of Computerized Retrieval	08

22PD45T: BIOPHARMACEUTICS AND PHARMACOKINETICS (THEORY)

Theory: 3 Hrs. /Week **75 Hours**

Course Outcome

At the end of the course students will be able to...

CO No.	Outcome statement
CO1	Define the basic concepts in biopharmaceutics and pharmacokinetics
CO2	Select the correct pharmacokinetic model based on plasma level or urinary excretion data that best describes the process of drug absorption, distribution, metabolism and elimination (ADME)
CO3	Determine the effect of Pharmacokinetic (ADME) parameters on the biological effects of the drug
CO4	Carry out biopharmaceutical studies and use data so obtained in the development of new drugs or dosage forms
CO5	Calculate various pharmacokinetic parameters from plasma and urinary excretion data applying compartment modeling and model independent methods
CO6	Design dosage regimens for patients based on calculated pharmacokinetic parameters
CO7	Design Bioavailability and Bioequivalence studies of new drugs or dosage forms
CO8	Evaluate drug-protein binding as a tool to predict pharmacokinetics of drugs

1. **Scope and Objectives:** This course is designed to impart knowledge and skills necessary for dose calculations, dose adjustments and to apply biopharmaceutics theories in practical problem solving. Basic theoretical discussions of the principles of biopharmaceutics and pharmacokinetics are provided to help the students' to clarify the concepts.

   At completion of this course it is expected that students will be able to:

   1. Define the basic concepts in biopharmaceutics and pharmacokinetics.
   2. Use raw data and derive the pharmacokinetic models and parameters the best describe the process of drug absorption, distribution, metabolism andelimination.

3. Critically evaluate biopharmaceutic studies involving drug productequivalency
4. Design and evaluate dosage regimens of the drugs usingharmacokinetic and biopharmaceutic parameters.
5. Detect potential clinica pharmacokinetic problems and apply basicpharmacokinetic principles to solve them

2. Course MaterialText books

a) Biopharmaceutics and Clinical Pharmacokinetics by, Milo Gibaldi.4th ed. 2005, Pharma Med Press
b) Biopharmaceutics and Pharmacokinetics; By Robert F Notari, 2010, Marcel Dekker,
c) Applied biopharmaceutics and pharmacokinetics, Leon Shargel and Andrew B.C.YU 7th edition,2016, Prentice-Hall Inernational edition.USA
d) Bio pharmaceutics and Pharmacokinetics-A Treatise, D. M. Brahmankar and Sunil B.Jaiswal,3rd. ed. 2015, Vallabh Prakashan Pitampura, Delhi

Reference Books

a) Pharmacokinetics: By Milo Gibaldi Donald, R.4th. ed. 2005, Mercel Dekker Inc.
b) Hand Bookof Clinical Pharmacokinetics, By Milo Gibaldi and LauriePrescott, 2005, 4th.ed., by ADIS Health Science Press.
c) Biopharmaceutics; By Swarbrick, Encyclopedia of PharmaceuticalTechnology, Vol. 1-3, 2nd. Ed. 2002,
d) Cilincal Pharmacokinetics, Concepts and Applications: By Malcolm Rowland and Thomas, N. Tozen, Lea and Febrger, Philadelphia, 4th ed.2010.
e) Dissolution, Bioavailability and Bioequivalence, By Abdou H.M, Mack, Publishing Company, Pennsylvania 1989.
f) Biopharmaceutics and Clinical Pharmacokinetics-An introduction 4th edition Revised and expanded by Rebort F Notari Marcel Dekker Inn,New York and Basel, 1987.
g) Remington's Pharmaceutical Sciences.Vol.1-3, 22th ed. 2010

3. Lecture wise programme

	Topics	Hrs
	I Biopharmaceutics	
1	Introduction to biopharmaceutics	01
2	**Absorption;** Mechanisms of drug absorption through GIT, factors influencing drug absorption though GIT, absorption of drug from Non *per OS* extra-vascular routes	08
3	**Distribution of drugs** Tissue permeability of drugs, binding of drugs, apparent volume of drug distribution, protein binding of drugs, factors affecting protein – drug binding. Kinetics of proteinbinding, Clinical significance of protein bin-drug binding	08
4	**Drug Elimination.** Biotransformation of drugs, renal excretion of drugs , factors affecting renal excretion of drugs, renal clearance, Non renal routes of drug excretion of drugs	06
5	**Bioavailability and Bioequivalence:** Objectives of bioavailability studies, absolute and relative bioavailability, measurement of bioavailability, *in-vitro* drug dissolution models, *in-vitro in-vivo* correlations, bioequivalence studies, methods to enhance the bioavailability	10
	II Pharmacokinetics	
6	Introduction to Pharmacokinetics. Mathematical model. Drug levels in blood. Pharmacokinetic models, Compartment models, Noncompartmentmodels, physiological models	05
7	**One compartment open model.** a. Intravenous Injection (Bolus) b. Intravenous infusion. c. extra vascular administrations, calculations of Ka, KE from plasma and urinary excretion data	15
8	**Multicompartment models**: Two compartment open model.IV bolus, IV infusion and oraladministration	08
9	**Multiple – Dosage Regimens**: a). Repititive Intravenous injections – OneCompartment Open Model b). Repititive Extravascular dosing – OneCompartment Open model	05

	c). Multiple Dose Regimen – Two CompartmentOpen Model	
10	**Nonlinear Pharmacokinetics.** a. Introduction, b. Factors causing Non-linearity. c. Michaelis-menton method of estimatingparameters	05
11	**Noncompartmental Pharmacokinetics**. Statistical Moment Theory,. MRT for various compartmentmodels. Physiological Pharmacokinetic Model	04

22PD45P: BIOPHARMACEUTICS AND PHARMACOKINETICS (PRACTICAL)

Practical: 3 Hrs./Week **75 Hours**

List of experiments

1. Improvement of dissolution characteristics of slightly soluble drugs by co-solvency
2. Improvement of dissolution characteristics of slightly soluble drugs bysolid dispersion
3. Improvement of dissolution characteristics of slightly soluble drugs by useofsurfactant
4. Comparison of dissolution studies of two different marketed products ofsamedrug.
5. Influence of polymorphism on solubility and dissolution
6. Protein binding studies of a drug.
7. Calculation of bioavailability
8. Calculation of Ka, Ke, t½ Cmax, AUC, AUMC, MRT etc. from bloodprofile data.
9. Calculation of bioavailability from urinary excretion data for two drugs.
10. Calculation of elimination half-life for different drugs by usingurinary elimination data and blood level data
11. Calculation of AUC and bioequivalence from the given data for two drugs
12. Absorption studies in animal inverted intestine using various drugs.
13. Studying metabolic pathways for different drugs based on eliminationkinetics data
14. Calculation of renal clearance

22PD46T: CLINICAL TOXICOLOGY (THEORY)

Theory: 2 Hrs. /Week **50 Hours**

Course Outcome

At the end of the course students will be able to...

CO No.	Outcome statement
CO1	Describe general principles involved in the management of poisoning
CO2	Differentiate the clinical symptoms of various acute poisonings
CO3	Manage the clinical symptoms of different acute poisonings
CO4	Distinguish the clinical symptoms of chronic poisoning by heavy metals
CO5	Manage the various clinical symptoms of different chronic poisoning by heavy metals
CO6	Recognize the clinical symptoms and management of envenomation, food poisoning and poisoning by various plants
CO7	Devise public and health care professionals in the management of emergency cases
CO8	Evaluate, minimize and prevent the substance abuse cases in local population

1. **Scope and Objectives:** This course is designed to impart a thorough knowledge in the management of various poisoning cases thereby enabling the students to assist healthcare professionals / toxicologists in handling and managing the emergency cases.

Upon completion of the course student shall be able to:

1. Understand and deal with general principles involved in the management ofpoisoning
2. Recognize the clinical symptoms and manage poisoning cases
3. Educate public and healthcare professionals in the management of emergency cases
4. Minimize/ prevent the poisoning cases in local populati

2. Course materials Reference Books:

a) Matthew J Ellenhorn. Ellenhorns Medical Toxicology – Diagnosis and Treatment of Poisoning. 2nd ed., 1997, Williams and Willkins publication, London

b) Modern medical toxicology, Author V. V. Pillay, 4th ed. 2013, Publisher: JP Brothers

c) Pediatric toxicology diagnosis and management of the poisoned child, Timothy B, Erickson, William R. Athrens, Steven.E. AK, Cart K.Baun,Louis J.Ling. Mcgraw-Hill; 2005.

d) Lindsay Murray, Frank Dary, Mark little, Mikes Cadogan, editors. Toxicology handbook. Australia: Churchil Livingstone, Elsevier; 2007

3. Lecture wise programme

Topics	**Hrs**
1. General principles involved in the management of poisoning	02
2. Antidotes and the clinical applications	01
3. Supportive care in clinical Toxicology	02
4. Gut Decontamination	02
5. Elimination Enhancement	01
6. Toxicokinetics	02
7. Clinical symptoms and management of acute poisoning with the following agents a) Pesticide poisoning: organophosphorous compounds, carbamates, organochlorines, pyrethroids b) Opiates overdose. c) Antidepressants d) Barbiturates and benzodiazepines e) Alcohol: ethanol, methanol f) Paracetamol and salicylates g) Non-steroidal anti-inflammatory drugs h) Hydrocarbons: Petroleum products and PEG. i) Caustics: inorganic acids and alkali j) Radiation poisoning	21
8. Clinical symptoms and management of chronic poisoning with the following agents - Heavy metals: Arsenic, lead, mercury, iron, copper	05
9. Venomous snake bites: Families of venomous	

	snakes, clinical effects of venoms, general managementas firstaid, early manifestations, complications and snakebite injuries	02
10.	Plants poisoning. Mushrooms, Mycotoxins	02
11.	Food poisonings	01
12.	Envenomations – Arthropod bites and stings	01
13.	**Substance abuse:** Signs and symptoms of substance abuse andtreatment of dependence a) CNS stimulants : Amphetamine b) Opioids c) CNS depressants d) Hallucinogens: LSD e) Cannabis group f) Tobacco	08

22PD47T: PHARMACOTHERAPEUTICS I & II (THEORY)

Theory: 3 Hrs. /Week **75 Hours**

Course Outcome

At the end of the course students will be able to...

CO No.	Outcome statement
CO1	Describe the etiopathogenesis of selected disease states
CO2	Discuss the various methods involved in the diagnosis of selected disease states
CO3	Interpret and analyze the selected laboratory results of specific disease states
CO4	Describe the therapeutic approach to manage the selected diseases
CO5	Discuss the rationale for drug therapy of the selected diseases
CO6	Identify the controversies in drug therapy
CO7	Develop the individualized therapeutic plans based on diagnosis
CO8	Describe the general prescribing guidelines for special population
CO9	Explain role of pharmacist in promoting rational drug use and essential drug concept

1. **Scope and Objectives:** This course is designed to impart knowledge and skills necessary for contribution to quality use of medicines. Chapters dealt cover briefly pathophysiology and mostly therapeutics of various diseases. This will enable the student to understand the pathophysiology of common diseases and their management.

   At completion of this course it is expected that students will be able to understand:

   1. The pathophysiology of selected disease states and the rationale for drugtherapy.
   2. The therapeutic approach to management of these diseases.
   3. The controversies in drug therapy.
   4. The importance of preparation of individualized therapeutic plans basedon diagnosis.
   5. Needs to identify the patient-specific parameters relevant in initiating

drug therapy, and monitoring therapy (including alternatives, time- course of clinical and laboratory indices of therapeutic response and adverse effects).

6. Describe the pathophysiology of selected disease states and explain therationale for drug therapy.
7. Summarise the therapeutic approach to management of these diseasesincluding reference to the latest available evidence.
8. Discuss the controversies in drug therapy.
9. Discuss the preparation of individualized therapeutic plans based on diagnosis.
10. Identify the patient-specific parameters relevant in initiating drug therapy, and monitoring therapy (including alternatives, time- course of clinical and laboratory indices of therapeutic response and adverse effects).

2. Course MaterialText Books

a) Clinical Pharmacy and Therapeutics; 5th.ed. 2012; Walker & Whittlesea,Churchill Livingstone publication.
b) Pharmacotherapy: A Pathophysiology approach - Joseph T. Dipiro et al.10thed., 2016, Appleton & Lange

Reference Books

a) Pathologic basis of disease by- Cotran, Kumar, Robbins Elsiver India Pvt Ltd, Newdelhi, 2015, ed. 9 vol. 1-2.
b) Pathology and Therapeutics for Pharmacists - A Basis for Clinical Pharmacy Practice - Green and Harris, 3rd. ed.,Chapman and Hall publication
c) Clinical Pharmacy and Therapeutics – Eric T. Herfindal, 5th ed. 2016, Williams and Wilkins Publication
d) Applied Therapeutics: The clinical Use of Drugs. Lloyd Young and Koda -Kimble MA, 10th ed. 2013, Wolters Kluwer Lippincot williams&Wilkins, Newyork
e) Avery's Drug Treatment, 4th Ed, 1997, Adis International Limited.
f) Relevant review articles from recent medical and pharmaceutical literature.

3. Lecture wise Programme

Etio pathogenesis and pharmacotherapy of diseases associated with followingsystems/ diseases

	Topics	Hrs
1.	**Cardiovascular system** Hypertension, Congestive cardiac failure, 13Angina Pectoris, Myocardial infarction, , Hyperlipidemia, Electrophysiology of heart and Arrhythmias	
2.	**Respiratory system** Introduction to Pulmonary function test, Asthma, Chronic obstructive airways disease, Drug induced pulmonary diseases.	06
3.	**Endocrine system** Diabetes, Thyroid diseases, Oral contraceptives,Hormone replacement therapy, Osteoporosis	08
4.	**General prescribing guidelines for** 4.1 Paediatric patients 4.2 Geriatric patients 4.3 Pregnancy and breast feeding	04
5.	**Ophthalmology:** Glaucoma, Conjunctivitis- viral & bacterial.	03
6.	**Introduction to rational drug use** Definition, Role of pharmacist Essential drugconcept Rational drug formulations.	02
7.	**Infectious disease:** Guidelines for the rational use of antibiotics and surgical Prophylaxis, Tuberculosis, Meningit is,Respiratory tract infections, Gastroenteritis, Endocarditis, Septicemia, Urinary tract infections, Protozoal infection- Malaria, HIV & Opportunistic infections, Fungal infections, Viral infections, Gonarrhoea and Syphillis.	18
8.	**Musculoskeletal disorders** Rheumatoid arthritis, Osteoarthritis, Gout, Spondylitis, Systemic lupus erythematosus.	06
9.	**Renal system** Acute Renal Failure, Chronic Renal Failure, Renal Dialysis, Drug induced renal disorders.	05

10.	**Oncology:** Basic principles of Cancer therapy,General introduction to cancer chemotherapeutic agents,Chemotherapyof breast cancer, leukemia.Management of chemotherapy nausea and emesis.	06
11.	**Dermatology:** Psoriasis, Scabies, Eczema, Impetigo.	04

22PD47P: PHARMACOTHERAPEUTICS I & II (PRACTICAL)

Practical: 3 Hrs./Week **75 Hours**

Hospital postings in various departments designed to complement the lectures by providing practical clinical discussion; attending ward rounds; follow up the progress and changes made in drug therapy in allotted patients; case presentation upon discharge. Students are required to maintain a record of cases presented and the same should be submitted at the end of the course for evaluation. A minimum of 15 cases should be presented and recorded coveringmost common diseases.

ASSIGNMENTS

Students are required to submit written assignments on the topics given to them. Topics allotted should cover recent developments in drug therapy of various diseases. A minimum of THREE assignments [1500 – 2000 words] should be submitted for evaluation.

Assignments

Format of the assignment

- Minimum & Maximum number of pages
- It shall be computer draft copy
- Reference(s) shall be included at the end.
- Name and signature of the student
- Assignment can be a combined presentation
- Time allocated for presentation at the end of the academic year may be 8+2Min

Scheme of Practical Examination

	Sessionals	**Annual**
Synopsis	05	15
Major Experiment	10	25
Minor Experiment	03	15
Viva	02	15
Max Marks	20	70
Duration	**03 hrs**	**04 hrs**

Note: Total sessional marks is 30 (20 for practical sessional plus 10 marks for regularity,promptness, viva-voce and record maintenance)

22PD51T: CLINICAL RESEARCH (THEORY)

Theory: 2 Hrs. /Week **50 Hours**

Course Outcome

At the end of the course students will be able to...

CO No.	Outcome statement
CO1	Describe the concept of new drug development process
CO2	Describe the various phases of clinical trials
CO3	Recognize the regulatory and ethical requirements in clinical trials
CO4	Describe the regulatory environment in USA, Europe and India
CO5	Recognize the roles and responsibilities of clinical trial study team
CO6	Develop the various clinical trial documents
CO7	Discuss various procedures and activities involved in the conduct of clinical trials
CO8	Interpret the various aspects of clinical trial data management

1. **Scope and Objectives**: This course is designed to make the students to understand the principles and gain adequate knowledge regarding the various approaches to drug discovery including clinical phase of development. Also enables the students to understand and implement all regulatory and ethical requirements that are required during the process of drug development.

   At completion of this course, it is expected that students will be able to:

   1. Know the concept of new drug development process.

   2. Understand the regulatory and ethical requirements.

   3. Conduct the clinical trials in accordance to regulatory and ethical requirements.

   4. Coordinate the clinical trials and promote quality drug trial research.

2. **Course material Text Books:**

   a) Principles and practice of pharmaceutical medicine, 3rd edition. Lionel. D. Edward,Aadrew.J.Flether Anthony W Fos , Peter D Sloaier Wiley;

   b) Handbook of clinical research. Julia Lloyd and Ann Raven Ed. Churchill Livingstone

c) Principles of Clinical Research edited by Giovanna di Ignazio, Di Giovanna and Haynes.2001, Director of CCA2000 Ltd, East Horsley, UK.

References:

a) Central Drugs Standard Control Organization. Good Clinical Practices- Guidelines for Clinical Trials on Pharmaceutical Products in India. New Delhi: Ministry of Health; 2001.
b) International Conference on Harmonisation of Technical requirements forregistration of Pharmaceuticals for human use. ICH Harmonised Tripartite Guideline. Guideline for Good Clinical Practice.E6; May 1996.
c) Ethical Guidelines for Biomedical Research on Human Subjects 2000. Indian Council of Medical Research, New Delhi.
d) Textbook of Clinical Trials edited by David Machin, Simon Day and Sylvan Green, ed. 2, March 2010, John Wiley and Sons.
e) Principles of Clinical Research edited by Giovanna di Ignazio, Di Giovanna and Haynes.2001, Director of CCA2000 Ltd, East Horsley, UK.
f) Clinical Data Management edited by R K Rondels, S A Varley, C F Webbs.2nd. Edition, Jan 2000, Wiley Publications.
g) Goodman Gilman, A., Rall, T.W., Nies, A.I.S. and Taylor, P. Goodman and Gilman's The pharmacological basis of therapeutics. 11th edition, 2006.Publisher McGraw Hill, Pergamon Press.

2. Lecture wise programme Topics **Hrs**

1. **Drug development process:** 10

   Introduction

   Various Approaches to drug discovery

   i. Pharmacological
   ii. Toxicological
   iii. IND Application
   iv. Drug characterization
   v. Dosage form

2. **Clinical development of drug:**

1.	Introduction to Clinical trials.	04
2.	Various phases of clinical trial.	06
3.	Methods of post marketing surveillance.	03
4.	Abbreviated New Drug Application submission.	03
5.	Good Clinical Practice – ICH, GCP, Central drug standard control organization (CDSCO) guidelines.	08 03
6.	Challenges in the implementation of guidelines.	02

7. Ethical guidelines in Clinical Research. 02
8. Composition, responsibilities, procedures of IRB / IEC. 10
9. Overview of regulatory environment in USA, Europe and India. 07
10. Role and responsibilities of clinical trial personnel as per ICH GCP
    a. Sponsor
    b. Investigators
    c. Clinical research associate
    d. Auditors
    e. Contract research coordinators 06
    f. Regulatory authority 02
11. Designing of clinical study documents (protocol, CRF, ICF, PIC 05
    with assignment). 04
12. Informed consent Process.
13. Data management and itscomponents.
14. Safety monitoring inclinical trials.

22PD52T: PHARMACOEPIDEMIOLOGY AND PHARMACOECONOMICS (THEORY)

Theory: 3 Hrs./Week **75 Hours**

Course Outcome

At the end of the course students will be able to...

CO No.	Outcome statement
CO1	Identify the applications of pharmacoepidemiology and pharmacoeconomics in clinical settings
CO2	Discuss the various pharmacoepidemiological outcome measures
CO3	Describe the concept of risk in pharmacoepidemiology and different methods of measuring risk
CO4	Explain the various pharmacoepidemiological methods
CO5	Explain the sources of data for pharmacoepidemiological studies
CO6	Explain the various systems for studying drug effects in populations
CO7	Discuss the methods to measure outcomes in pharmacoecnomic studies
CO8	Describe the current pharmacoeconomic evaluation methods

1. **Scope and Objectives:** This course is designed to impart knowledge regarding various methods and applications of pharmacoepidemiology and pharmacoeconomics in drug safety monitoring, drug approval and regulations. **Upon completion of this course, it is expected that students will be able to -**
   1. Understand drugs use pattern and their outcome measures
   2. Conduct pharmacoepidemiological studies
   3. Adopt the tools effectively in evaluating risk and benefit of therapy
   4. Conduct pharmacoeconomic studies and evaluate the cost-benefit ratio
2. **Course Materials:**

   Reference Books

   a) Pharmacoeconomics and outcomes:Applications for patient care, case studies, Graer DW,Lee J,OdomTD,et al. American college of clinical

pharmacy- 2003.

b) Introduction to Applied Pharmacoeconomics, F. Randy Vogenberg, NewYork; London: McGraw-Hill,

c) Pharmacoepidemiology Editor Brian L Storm, John Wiley and Sons, Ltd4th edition,

d) Clinical epidemiology- How to do clinical Practice Research. 3rd edition,Brian Haynes, David L Sachett, Lippinkot

3. Lecture wise programme

	Topics	Hrs
1	**Pharmacoepidemiology :** **Definition and scope:** Origin and evaluation of Pharmacoepidemiology, need forpharmacoepidemiology, aims and applications of Pharmacoepidemiology	06
2	**Measurement of outcomes in pharmacoepidemiology** Outcome measure and drug use measures Prevalence, incidence and incidence rate. Monetary units, number of prescriptions, units of drugs dispensed, defined daily dosesand prescribed daily doses, medication adherence measurement	06
3	**Concept of risk in pharmacoepidemiology** Measurement of risk, attributable risk, relative risk, time-risk relationship and odds ratio	06
4	**Pharmacoepidemiological methods** Includes theoretical aspects of various methods and practical study of various methods with the help of case studies for individual methods; Drug utilization review, case reports, case series, surveys of drug use, cross – sectional studies, cohort studies, case control studies, case –cohort studies, meta – analysis studies, spontaneous reporting, prescription event monitoring and record linkage system.	21
5	**Sources of data for pharmacoepidemiological studies** Ad Hoc data sources and automated data systems.	04
6	**Selected special applications of pharmacoepidemiology** Studies of vaccine safety, hospital pharmacoepidemiology,pharmacoepidemiology and risk management and drug induced birth defects.	08

7	**Phrmacoeconomics:** Definition, history, needs of pharmacoeconomic evaluations Role in formulary management decisions Pharmacoeconomic evaluation Outcome assessment and types of evaluation, Includes theoretical aspects of various methods and practical studyof various methods with the help of case studies for individual methods: Cost – minimization, cost- benefit, cost – effectiveness andcost utility Applications of Pharmacoeconomics Software and case studies (assignment discussion)	24

22PD53T: CLINICAL PHARMACOKINETICS AND THERAPEUTIC DRUG MONITORING (THEORY)

Theory: 2 Hrs./Week **50 Hours**

Course Outcome

At the end of the course students will be able to...

CO No.	Outcome statement
CO1	Formulate and design a dosage regimen for individual patients
CO2	Interpret and correlate the plasma drug concentration with patient's therapeutic outcomes
CO3	Recommend dosage adjustment in renal and hepatic disease
CO4	Recommend dosage adjustment for paediatrics, geriatrics and obese patients
CO5	Analyze and resolve pharmacokintetic drug interactions
CO6	Illustrate and apply pharmacokinetic parameters in clinical settings
CO7	Interpret the impact of genetic poylmorphisms of individuals on pharmacokinetics and pharmacodynamics of drugs
CO8	Employ pharmacokinetic modeling for the given data using the principles of pharmacometrics

1. **Scope and Objectives:** This course is designed to make the students to understand and apply pharmacokinetic principles in designing/ individualizing dosage regimen. Also, enable the students to interpret the plasma drug range, and hepatic / renal function in optimizing the drug therapy.

   On completion of the course, the student shall be able to:

   1. Design the drug therapy regimen for individual patient
   2. Interpret and correlate the plasma drug concentration with patient'stherapeutic outcome.
   3. Recommend dosage adjustment for patients with renal/ hepatic impairment
   4. Detect and manage drug –drug interactions

2. Course materials: Reference Books

a) Applied Pharmacokinetics & Pharmacodynamics: Principles of Therapeutic Drug Monitoring; Michael E. Burton, Leslie M. Shaw, Jerome J. Schentag, William E. Evans Lippincott Williams & Wilkins,4th., ed. 2005,

b) Handbook of Analytical Therapeutic Drug Monitoring and Toxicology By Steven How-Yan Wong, Irving Sunshine, Published by CRC Press,1996

c) Clinical pharmacokinetics, Author: Soraya Dhillon, Andrzej Kostrzewski, Publisher: Pharmaceutical Press

d) Cilincal Pharmacokinetics, Concepts and Applications: By . Rowland and Thomas, N. Tozen, Lea and Febrger, Philadelphia, 4th ed. 2010

e) Biopharmaceutics and Applied Pharmacokinetics, Leon Shargel, 6th ed.2013, Prentice Hall Publication

3. Lecture wise Programme:

Topics	**Hrs**
1. **Introduction to Clinical pharmacokinetics.**	01
2. **Design of dosage regimens** Nomograms and Tabulations in designing dosage regimen, conversion from intravenous to oral dosing, determination of dose and dosing intervals, drugdosing in the elderly and pediatrics and obese patients	07
3. Pharmacokinetics of Drug Interaction: a. Pharmacokinetic drug interactions b. Inhibition and Induction of Drug metabolism c. Inhibition of Biliary Excretion.	03
4. Therapeutic Drug monitoring: a) Introduction b) Individualization of drug dosage regimen (Variability – Genetic, age, weight, disease andInteracting drugs). c) Indications for TDM, Protocol for TDM. d) Pharmacokinetic/Pharmacodynamic Correlation in drug therapy. e) TDM of drugs used in the following conditions: Cardiovascular disease, Seizure disorders, Psychiatric conditions, and Organ transplantations.	20
5. Dosage adjustment in Renal and hepatic Disease. a. Renal impairment	10

b. Pharmacokinetic considerations
c. General approach for dosage adjustment in Renal disease.
d. Measurement of Glomerular Filtration rate.
e. Dosage adjustment for uremic patients.
f. Extracorporeal removal of drugs.
g. Effect of Hepatic disease on pharmacokinetics.

6. Population Pharmacokinetics. 05

a. Introduction to Bayesian Theory.
b. Adaptive method or Dosing with feedback.
c. Analysis of Population pharmacokinetic Data.

7. Pharmacogenetics 04

a. Genetic polymorphism in Drug metabolism: Cytochrome P-450 Isoenzymes.
b. Genetic Polymorphism in Drug Transport and Drug Targets.
c. Pharmacogenetics and Pharmacokinetics /Pharmacodynamic considerations

Pharm. D. - Sixth Year
INTERNSHIP
(See regulation 16.1.6)

1) SPECIFIC OBJECTIVES:

i. to provide patient care in cooperation with patients, prescribers, and other members of an inter-professional health care team based upon soundtherapeutic principles and evidence-based data, taking into account relevant legal, ethical, social cultural, economic, and professional issues, emerging technologies, and evolving biomedical, pharmaceutical, social or behavioral or administrative, and clinical sciences that may impact therapeutic outcomes.

ii. to manage and use resources of the health care system, in cooperation with patients, prescribers, other health care providers, and administrative and supportive personnel, to promote health; to provide, assess, and coordinate safe, accurate, and time-sensitive medication distribution; and to improve therapeutic outcomes of medicationuse.

iii. to promote health improvement, wellness, and disease prevention in co -operation with patients, communities, at-risk population, and other members of an inter- professional team of health care providers.

iv. to demonstrate skills in monitoring of the National Health Programmes and schemes, oriented to provide preventive and promotive health careservices to the community.

v. to develop leadership qualities to function effectively as a member of the health care team organised to deliver the health and family welfare services in existing socio- economic, political and culturalenvironment.

vi. To communicate effectively with patients and the community.

2) OTHER DETAILS:

i. All parts of the internship shall be done, as far as possible, in institutions in India. In case of any difficulties, the matter may be referred to the Pharmacy Council of India to be considered on merits.

ii. Where an intern is posted to district hospital for training, there shall be a committee consisting of representatives of the college or university, and the district hospital administration, who shall regulate the training of such trainee. For such trainee a certificate of satisfactory completion

of training shall be obtained from the relevant administrative authorities which shall be countersigned by the Principal or Dean of College.

iii. Every candidate shall be required, after passing the final Pharm.D. Or Pharm.D.(Post Baccalaureate) examination as the case may be to undergo compulsory rotational internship to the satisfaction of the College authorities and University concerned for a period of twelve months so as to be eligible for the award of the degree of Pharm.D. or Pharm.D. (Post Baccalaureate) as the case may be.

3. ASSESSMENT OF INTERNSHIP:

i) The intern shall maintain a record of work which is to be verified and certified by the preceptor (teacher practioner) under whom he works. Apart from scrutiny of the record of work, assessment and evaluationof training shall be undertaken by an objective approach using situation tests in knowledge, skills and attitude during and at the end of the training. Based on the record of work and date of evaluation, the Dean or Principal shall issue certificate of satisfactory completion of training, following which the university shall award the degree or declare him eligible for it.

ii) Satisfactory completion of internship shall be determined on the basis of the following:-

1.	Proficiency of knowledge required for each case management	SCORE 0-5
2.	The competency in skills expected for providing Clinical Pharmacy Services	SCORE 0-5
3.	Responsibility, punctuality, work up of case, involvement in patient care	SCORE 0-5
4.	including medical doctors, nursing staff and	SCORE 0-5
5.	Initiative, participation in discussions, research	SCORE 0-5

Poor	Fair	Below Average	Average	Above Average	Excellent
0	1	2	3	4	5

A Score of less than 3 in any of above items will represent unsatisfactorycompletion of internship.

PCI NOTIFICATION - I

Ref.No.50-100(R)/2009-PCI/28059-92 Dated-17/01/2011

All the State Pharmacy Councils/Registration Tribunals

Sub: Registration procedure of Pharm.D. (Doctor of Pharmacy) passed outstudents.

Sir/Madam

In exercise of the powers conferred by section 10 of the Pharmacy Act, 1948 (8 of 1948), the Pharmacy Council of India, with the approval of the Central Government vide Notification No.19, Part III - Section 4, dated 10th - 16th May, 2008 had published Pharm.D. Regulations, 2008 in the Gazette of India.

Under the said Pharm.D. Regulations -

a) Every student who has passed the examinations for the Pharm.D. (Doctor of Pharmacy) or Pharm.D. (Post Baccalaureate) (Doctor of Pharmacy) as the case may be, shall be granted a certificate by the examining authority.
b) Pharm.D. shall consist of a certificate, having passed the course of study and examination as prescribed in these regulations, for the purpose of registration as a pharmacist to practice the profession under the Pharmacy Act, 1948.
c) The eligibility criteria for admission to Pharm.D. course is as follows –

Level Qualification	Duration of the Course
• 10 + 2 Science academic stream Or • D.Pharm	6 years
• B.Pharm	3 years

d) The above Pharm.D. course includes one year of internship in hospital as per Pharm.D. Regulations, 2008.

The first batch of Pharm.D students admitted during 2008-2009 with B.Pharm entry level qualification will pass the Pharm.D. course in 2010-2011 academic session. These students will approach the State Pharmacy Council for registration as a pharmacist u/s 32(2) of the Pharmacy Act, 1948.

In view of above, it is requested to -

a) register these Pharm.D. students as "Doctor of Pharmacy" u/s 32(2) of thePharmacy Act, 1948.
b) maintain separate register for Pharm.D. registrations and forward the same toPCI for Central Register.
c) ensure that following conditions of section 32(2) of the Pharmacy Act, 1948 arestrictly complied with -
    i. the candidate shall be of 18 years ormore.
    ii. he/she should reside or carry on the business or profession of pharmacy in theState.
    iii. he/she should have pass an approved examination i.e. he/she should have pass the Pharm.D. course from an institution approved by the PCI u/s 12 of the Pharmacy Act.
    iv. the approval status of such institutions can be verified from -
        - Council's website "www.pci.nic.in".
        - Council's Notifications issued from time to time.

Please note that if the course is approved only for the "conduct of study" and not u/s 12 of the Pharmacy Act for the purpose of registration as a pharmacist, students are not eligible for registration. Further please find enclosed herewiththe registration procedure in detail for strict compliance at your end.

Yours
faithfullySd/-
(ARCHNA MUDGAL)
Registrar-cum-Secretary

PCI NOTIFICATION - II

Ref. No. 14-126/2010-PCI / 28844-947 Dated: 30.9.2011

To All Universities

Sub: Clarification on Pharm.D qualification.

Sir/Madam

With reference to the subject cited above, I directed to inform that subject cited issue was considered by the 88th /CC in its meeting held in August, 2011 & decided to forward a clarification to all universities that Pharm.D is a PG qualification and passed out students can directly register for Ph.D.

This is for information.

Yours
faithfullySd/-
(ARCHNA MUDGAL)
Registrar-cum-Secretary

Nav/14-126 letter /hd-2/p-11/7.9.1/27.9.11

PCI NOTIFICATION - III

Ref. No. 14-126/2010-PCI/34094-36202 Dated 21.11.2011

All D.Pharm, B.Pharm & Pharm.D institutions approved

- **u/s 12 of the Pharmacy Act, 1948**
- **for conduct of "course of study"**

Sub: Pharm.D an approved qualification for teaching.

Sir/Madam

It may kindly be recalled that vide notification published in Gazette of India, Part- III, Section-4, No. 19, May 10- May 16, 2008, the Pharmacy Council of India has introduced Pharm.D qualification as a registrable qualification under the Pharmacy Act, 1948.

In this connection, I am directed to inform that Pharm.D. qualification from an institution approved by the PCI u/s 12 of the Pharmacy Act 1948 is an approved qualification for teaching D.Pharm, B.Pharm, M.Pharm and Pharm.D./ Pharm.D (Post Baccalaureate) courses. As such a candidate holding Pharm.D. qualification from an institution approved by the PCI u/s 12 of the Pharmacy Act, 1948 shall be eligible for consideration for teaching posts at appropriate level in pharmacy institutions.

This is for
information.

Yours faithfully

Sd/-
(ARCHNA MUDGAL)
Registrar-cum-Secretary

PCI NOTIFICATION – IV

Ref.No.14-126/2012-PCI/46595-618 Dated: 16th February 2012

To
All Universities/Examining Authorities approved by the PCI in respect of Pharm.D/Pharm.D (Post Baccalaureate) course.

Sub: Pharm.D Course - Clarification regarding nomenclature of Pharm.D/ Pharm.D (Post Baccalaureate) on pass certificates.

Ref: Council's circular No. 14-126/2012-PCI/46011-36 dt.8.2.2012.

Sir/Madam

This has a reference to the subject cited above.

It has been brought to the notice of the Council that some Universities are not prefixing "Dr." before the name of the candidate in the provisional as well as final degree pass certificate issued by the university in respect of students passing Pharm.D/Pharm.D (Post Baccalaureate) from an institution approved by the Pharmacy Council of India u/s 12 of the Pharmacy Act, 1948.

In view of above, it is requested to use the prefix "Dr." before the name of the candidate while awarding the degree of Doctor of Pharmacy under regulation 18 ofthe Pharm.D. Regulations, 2008.

This is for information and necessary action at your end. Yours faithfullySd/-

(ARCHNA MUDGAL)
Registrar-cum-Secretary

PHARMACY COUNCIL OF INDIA

(Constituted under the Pharmacy Act, 1948)

E-MAIL : registrar@pci.nic.in
WEBSITE : www.pci.nic.in
Telephone : 011-61299901
011-61299902
011-61299903

NBCC Centre, 3rd Floor,
Plot No.2, Community Centre
Maa Anandamai Marg
Okhla Phase I
NEW DELHI – 110 020

Ref. No.14-55/2021-PCI(A)/3642-45 23 SEP 2021

To

a) All institutions approved for D.Pharm Course.

b) All State Governments (Technical Education and Health Departments) and admission making authorities.

c) All Examining Authorities.

Sub: "Syllabus framed under Regulation 7, List of prescribed equipments and apparatus under Appendix-A of The Education Regulations, 2020 for Diploma Course in Pharmacy."

Sir/Madam

With reference to the subject cited above, it is informed that -

1. With due approval of the Ministry of Health and Family Welfare, Government of India, PCI has notified the Education Regulations, 2020 for Diploma course in Pharmacy in the Gazette of India, Extraordinary No. 435, Part-III, Section-4, dt.16.10.2020.

2. As empowered under regulation 7 and Appendix-A of ER-20, the PCI has framed the syllabus. A copy of the same titled as under is enclosed as **Annexure-I.**

   "Syllabus framed under Regulation 7, List of prescribed equipments and apparatus under Appendix-A of The Education Regulations, 2020 for Diploma Course in Pharmacy."

3. It is for implementation and strict compliance from 2021-2022 academic session.

Yours faithfully

(ARCHNA MUDGAL)
Registrar-cum-Secretary

Annexure - I

Pharmacy Council of India
New Delhi

"Syllabus framed under Regulation 7, List of prescribed equipments and apparatus under Appendix-A of The Education Regulations, 2020 For Diploma Course in Pharmacy"

COMMITTEE MEMBERS

S. No.	Name	Affiliation	Role
1.	Dr. B. Suresh	President, Pharmacy Council of India, New Delhi	Ex-Officio
2.	Dr. Shailendra Saraf	Vice President, Pharmacy Council of India, New Delhi	Ex-Officio
3.	Dr. V. Gopal	Member, Pharmacy Council of India, (Puducherry)	Convener
4.	Dr. B. Jayakar	Member, Pharmacy Council of India, (Tamil Nadu)	Member
5.	Sri Kumar Ajay	Member, Pharmacy Council of India, (Bihar)	Member
6.	Dr. H. Lalhlenmawia	Member, Pharmacy Council of India, (Mizoram)	Member
7.	Dr. R. Debnath	Member, Pharmacy Council of India, (West Bengal)	Member
8.	Shri Annada Sankar Das	Member, Pharmacy Council of India, (Orissa)	Member
9.	Dr. Priyashree Sunita	Member, Pharmacy Council of India, (Jharkhand)	Member
10.	Dr. Mannava Radhakrishna Murthy	Member, Pharmacy Council of India, (Andhra Pradesh)	Member
11.	Shri Prakash Jeevandas Wanjari	Member, Pharmacy Council of India, (Maharashtra)	Member
12.	Shri K.R. Dinesh Kumar	Member, Pharmacy Council of India, (Kerala)	Member
13.	Mrs. Manjiri Sandeep Gharat	Principal I/c., Prin. K.M. Kundnani Pharmacy Polytechnic, Ulhasnagar, Maharashtra	Member
14.	Shri Raj Vaidya	Community Pharmacist, Hindu Pharmacy, Goa	Member
15.	Dr. R.N. Gupta	Professor, Birla Institute of Technology, Ranchi, Jharkhand.	Member
16.	Dr. K.P. Arun	Associate Professor, JSS College of Pharmacy, Ooty, Tamil Nadu	Member
17.	Dr. Neeraj Upmanyu	Professor & Dean, School of Pharmacy & Research, People's University Bhopal, Madhya Pradesh	Special Invitee

CONTENTS

1. Preamble

“Revamping the curriculum, pedagogy, assessment, and student support” is one of the vision statements and recommendations of the National Education Policy (NEP) of Govt. of India for attaining enhanced learning experiences by the students. In light of this, Pharmacy Council of India, the apex body regulating the pharmacy education in the country, committed to revise the education regulations of Diploma in Pharmacy (D.Pharm) program and thus, the ‘Education Regulations 2020’ (ER-2020) has been notified in the Gazette of India in October 2020. This new regulation has given due consideration for the fact that, universally the role of pharmacist has undergone continuous evolution from ‘dispenser of medicines’ to ‘medicine expert’ in the multidisciplinary health care team.

Accordingly, the courses (course means the subject) of the existing education regulations (ER-91) have been revisited, compared with the present and future needs of the society, expectations of the healthcare team and other stakeholders from the pharmacists were assessed, feedback from the experts in the pharmacy and other healthcare professions were sought. Thus, the course of study prescribed in ER-2020 is an amalgamation of all such exercises to arrive at a curriculum structure for D.Pharm that is more relevant to the current practice standards, dynamic to accommodate and address the upcoming changes.

Though the total number of courses across the program remain 21 as that of ER-91, the number of theory courses is reduced from 12 to 11 in the new regulation, while the number of practical courses is increased from 9 to 10. Further, the theory teaching hours across the program have been reduced from 850 to 825, while the practical hours have been increased from 750 to 800 in the new regulation. Three practical courses have been introduced for the first time in ER-2020. Further, about 275 hours have been assigned for the first time in D.Pharm curriculum for ‘Tutorial’ activities. All such changes explicitly reveal that the ER-2020 is intended to provide a little edge to the experiential learning through the practical courses and encourages the small group teaching-learning, self-directed learning, etc. in the tutorial hours.

Introduction of ‘Pharmacotherapeutics’ courses (theory and practical) is one of the revolutionary changes in the new curriculum, that will help the students to hone their knowledge and skills in the area of pharmaceutical care services which will certainly redefine the roles of the D.Pharm qualified pharmacists in both community and hospital settings. Also, the introduction of ‘Social Pharmacy’ courses (theory and practical) will provide insights about the primary and preventive healthcare concepts in the country and the potential roles of pharmacists in such healthcare segments.

In this backdrop, the Council has formulated a Committee which comprised of 16 Members who have rich experiences in various domains such as education, hospital

pharmacy practice, community pharmacy practice, clinical pharmacy practice, administrative and regulatory affairs to design the syllabus for the individual theory and practical courses as per the curriculum framework defined in ER-2020. The Committee with its clear understanding about the philosophy and objectives of the ER-2020, drafted the syllabus for individual theory and practical courses with utmost care to avoid repetitions, redundancy, over/under utilization of hours, etc. Every course is defined with scope, set of course objectives and course outcomes which will help to understand the significance and the expectations of the course from both teachers and students. Lots of scope has been given in the syllabus for the active learning by the students through the assignment topics and field visit activities which will enhance their critical thinking, searching scientific literatures, interpretational skills and communication skills.

According to the ER-2020 curriculum framework, the students do not earn any credits based on the academic hours they spend. However, as per the conventional methodology of credit calculations, the curriculum of ER-2020 shall be deemed equivalent to 80 credits that shall be used for the administrative purposes, wherever necessary.

Further, the 'Competencies for the Indian D.Pharm Holders' based on the knowledge, skill, attitude and value that are essential for the successful practice of the profession have been derived. These competencies have also been mapped with the individual courses of the curriculum based on the expected outcomes of the individual course. Thus, the courses and the competencies are interlaced in such a way that multiple courses contribute to build one competency and one course contributes to build more than one competency, which reveal the strength of the competency mapping.

The Council strongly believes that the ER-2020 regulations, curriculum and syllabus will uplift the knowledge and skills of the students on par with the contemporary and future professional demands and enable them to be a successful practitioner in the chosen field of pharmacy.

By considering the substantial changes and inclusion of advanced and current subject matters in the new syllabus, the Council shall conduct series of meetings, seminars, conferences, workshops, and webinars for the faculty members handling D.Pharm courses and equip them to deliver such new courses / topics more effectively and efficiently.

The Council appreciate all the efforts of the Members for successfully bringing out the Education Regulations 2020, curriculum and syllabus. Also, profound gratitude to all the stakeholders who contributed directly or indirectly in completing this task.

2. Competencies for the Indian D.Pharm Holders

Competency is defined as “A distinct composite of knowledge, skill, attitude and value that is essential to the practice of the profession in real life contexts”.

The candidates who successfully complete the Diploma in Pharmacy (D.Pharm) program of Education Regulations 2020 (ER-2020), from the institutions approved by the Pharmacy Council of India are expected to attain the following professional competencies.

1. Review Prescriptions
2. Dispense Prescription / Non-Prescription Medicines
3. Provide Patient Counselling / Education
4. Hospital and Community Pharmacy Management
5. Expertise on Medications
6. Proficiency on drugs / pharmaceuticals
7. Entrepreneurship and Leadership
8. Deliver Primary and Preventive Healthcare
9. Professional, Ethical and Legal Practice
10. Continuing Professional Development

1. Review Prescriptions: The student should receive and handle prescriptions in a professional manner and be able to check for their completeness and correctness. Also, the prescribers should be contacted for any clarifications and corrections in the prescriptions with suggestions if any.

2. Dispense Prescription / Non-Prescription Medicines: The student should be able to dispense the various scheduled drugs / medicines as per the implications of the Drug & Cosmetics Act and Rules thereunder. Also, the non-prescription medicines (over-the-counter drugs) should be dispensed judicially to the patients as required.

3. Provide Patient Counselling / Education: The student should be able to effectively counsel / educate the patients / caretakers about the prescription / non-prescription medicines and other health related issues. Effective communication includes using both oral and written communication skills and various communication techniques.

4. Hospital and Community Pharmacy Management: The student should be able to manage the drug distribution system as per the policies and guidelines of the hospital pharmacy, good community pharmacy practice and the recommendations of regulatory agencies. Also, be able to manage the procurement, inventory, and distribution of medicines in hospital / community pharmacy settings.

5. Expertise on Medications: The student should be able to provide an expert opinion on medications to health care professionals on safe and effective medication-use, relevant policies and procedures based on available evidences.

6. Proficiency on Pharmaceutical Formulations: The student should be able to describe the chemistry, characteristics, types, merits and demerits of both drugs and excipients used in pharmaceutical formulations based on her/his knowledge and scientific resources.

7. Entrepreneurship and Leadership: The student should be able to acquire the entrepreneurial skills in the dynamic professional environments. Also, be able to achieve leadership skills through teamwork and sound decision-making skills.

8. Deliver Primary and Preventive Healthcare: The student should be able to contribute to various healthcare programs of the nation including disease prevention initiatives to improve public health. Also contribute to the promotion of national health policies.

9. Professional, Ethical and Legal Practice: The student should be able to deliver professional services in accordance with legal, ethical, and professional guidelines with integrity.

10. Continuing Professional Development: The student should be able to recognize the gaps in the knowledge and skills in the effective delivery of professional services from time to time and be self-motivated to bridge such gaps by attending continuing professional development programs.

3. Competency Mapping with the Courses (Part I, II & III) of Education Regulations 2020

Competencies	Pharmaceutics	Pharmaceutical Chemistry	Pharmacognosy	Human Anatomy & Physiology	Social Pharmacy	Pharmacology	Community Pharmacy & Management	Biochemistry & Clinical Pathology	Pharmacotherapeutics	Hospital & Clinical Pharmacy	Pharmacy Law & Ethics	Practical Training
1. Review the Prescriptions	√	√	√	√		√	√	√	√	√	√	√
2. Dispense Prescription / Non-Prescription Medicines	√	√	√		√	√	√	√	√	√	√	√
3. Provide Patient Counselling / Education	√	√	√	√	√	√	√	√	√	√	√	√
4. Hospital and Community Pharmacy Management					√		√			√	√	√
5. Expertise on Medications	√	√	√	√	√	√	√	√	√	√	√	√
6. Proficiency on Pharmaceutical Formulations	√	√	√			√			√			√
7. Entrepreneurship and Leadership							√			√		√
8. Deliver Primary and Preventive Healthcare				√	√	√	√	√	√	√	√	√
9. Professional, Ethical and Legal Practice					√		√		√	√	√	√
10. Continuing Professional Development	√	√	√		√	√	√		√	√	√	√

4. ER-2020 D.Pharm Syllabus – An Overview

The ER-2020 D.Pharm Syllabus has the following structure in every course. Though the theory and practical courses are not mutually exclusive, as per the Regulations, the theory and practical are to be considered as individual courses.

Scope: These are broader statements on the purpose of the course in the curriculum, key contents of the course that will contribute to the specific knowledge and or skill developments. The teacher is expected to orient the students about the scope of the particular course at the beginning and intermittently.

Course Objectives: The course objectives describe the key topics that are intended by the teacher to be covered in the course. In general, these are more specific than the scope and broader than the course outcomes. The teacher is expected to discuss the objectives of the course with the students and break-down the course objectives into micro levels as objectives of a specific topic / objectives of a specific lecture, etc. Such an exercise shall make the students to understand the significance of the course / topic / lecture and enhance their attention on the course / topic / lecture.

Course Outcomes: The course outcomes are more specific than the course objectives describe that describe the abilities of the students to perform/act, upon successful completion of the course. Hence, conventionally the course outcomes are described with verbs that are measurable or observable actions. The teacher is expected to describe the desired outcomes of the particular course, so that the students shall understand the various assessment criteria, modalities, and parameters. This also serves as a broader guideline for the teachers for preparing the assessment plan. A well-structured assessment plan associated with the course outcomes shall enable to mapping with the professional competencies and their attainment levels that are attributed to the program outcomes.

Theory Courses: The theory courses basically provide concepts and explain the relationships between the concepts. Understanding of the theoretical courses enable the students to identify the problems in real life situation and make a plan for addressing such problems. Also, the theory course helps to understand what is not known and thus is the tool for accumulation of knowledge. The syllabus of the theory courses has been systematically and logically described as different chapters and the minimum number of hours to be spent on teaching are mentioned chapter wise and course wise. The teachers shall further distribute the total hours of any given chapter among the sub-topics as required by the subject matter.

Practical Courses: The practical courses are designed for applying the theoretical knowledge in the given experimental / simulated conditions. The practical courses deepen the understanding of theories, develop the skills, hone professional competencies, provide opportunities to observe, think and analyse problem solving methods. Further, they help to gain experience with the real things in practice. The teachers shall train the students in actual / simulated practical conditions.

Tutorials: The purpose of the tutorial hour is typically to engage the students in smaller groups in order to pay a closer attention on their learning process. This is an opportunity for the students to complete their assignments, develop specific skills, discuss any problems in the study topics in a less formal way. During the tutorial hour, the students shall exchange their ideas within the small group, and learn to accept constructive criticism and listen to others. Also, the tutorial hour enables the teachers to closely monitor the progress of the individual student and provide additional academic support to individuals, if necessary.

Assignments: The purpose the assignments are to encourage the students for self-directed learning. Further, the assignments will provoke critical thinking, enhance the skills such as literature search, data mining, data interpretation, report formatting, time-management, and written communication. This is also a mode of self-assessment for the student about the level of understanding of the concepts of a particular course. The teachers shall apply their knowledge and wisdom in choosing the assignment topics at a micro level in alignment with the topics given in the syllabus. The assignments shall be evaluated against a set of criteria. A typical format for the assessment of an assignment is given in Appendix-1.

Field Visits: The purpose of field visits is to provide a real-world experience to the students. The field visits will help them to realize that what they learn within the walls of the classroom / laboratory can help them solve the problems they see in the world around them. Also, this is helpful to the teachers to widen their horizons of knowledge and broadening the scope of the syllabus. Every student shall submit a report describing their objectives, experience, learning points, etc. pertaining to the field trip, in the typical format given in Appendix-2.

Recommended Books: For each course, a list of recommended books is given in the syllabus. The list shall be considered as an important and common resource for the teaching-learning process, but not the complete list. It is always encouraged to use the latest edition of the books specified. Further, the teachers and students are encouraged to explore more primary, secondary, and tertiary resources as required.

Practical Training: The goal of the practical training for the students is to provide a real-time, supervised experience on the professional tasks emphasised in their course of study. Further, it helps them to apply their acquired knowledge and skills in the professional working environment. The practical training intensively prepares the students with adequate competencies and qualifications required for the career opportunity in the future.

Thus, the ER 2020 D.Pharm syllabus is designed to nurture the students in all the three domains of Bloom's Taxonomy viz. cognitive (knowledge), affective (attitude) and psychomotor (skills). Further, it also provides ample of scope to the students for different learning styles viz. visual, auditory and kinaesthetic, i.e., 'see, hear and do'.

The summary of the curriculum, courses and other activities and their metrics across the ER-2020 D.Pharm program (Part I, II & III) are given here.

Criteria	Metrics
Number of subject areas (considering both theory & practical together)	11
Number of theory courses	11
Number of practical courses	10
Number of theory hours	825
Number of practical hours	600
Number of practical training hours	500
Number of tutorial hours	275
Number of course outcomes for theory courses	45
Number of course outcomes for practical courses	40
Number of courses which have given assignments	9
Number of assignment topics given	75
Number of assignments reports each student shall submit	27
Number of courses which have field visit	5
Number of field visit reports each student shall submit	9
Number of professional competencies	10

5. Guidelines for the conduct of theory examinations

Sessional Examinations

There shall be two or more periodic sessional (internal assessment) examinations during each academic year. The duration of the sessional exam shall be 90 minutes. The highest aggregate of any two performances shall form the basis of calculating the sessional marks. The scheme of the question paper for theory sessional examinations shall be as given below.

I. Long Answers (Answer 3 out of 4)	3 x 5 = 15
II. Short Answers (Answer 5 out of 6)	5 x 3 = 15
III. Objective type Answers (Answer all 10 out of 10) (Multiple Choice Questions / Fill-in the Blanks / One word OR one Sentence questions)	10 x 1 =10
Total =	40 marks

Internal assessment: The marks secured by the students out of the total 40 shall be reduced to 20 in each sessional, and then the internal assessment shall be calculated based on the best two averages for 20 marks.

Final Board / University Examinations

The scheme of the question paper for the theory examinations conducted by the examining authority (Board / University) shall be as given below. The duration of the final examination shall be 3 hours.

I. Long Answers (Answer 6 out of 7)	=	6 x 5 = 30
II. Short Answers (Answer 10 out of 11)	=	10 x 3 = 30
III. Objective type Answers (Answer all 20) (Multiple Choice Questions / Fill-in the Blanks / One word OR one Sentence questions)	=	20 x 1 = 20
Total	=	80 marks

6. Guidelines for the conduct of practical examinations

Sessional Examinations

There shall be two or more periodic sessional (internal assessment) practical examinations during each academic year. The duration of the sessional exam shall be three hours. The highest aggregate of any two performances shall form the basis of calculating the sessional marks. The scheme of the question paper for practical sessional examinations shall be as given below.

I. Synopsis	=	10
II. Experiments	=	50*
III. Viva voce	=	10
IV. Practical Record Maintenance	=	10

Total	=	80 marks

***** The marks for the experiments shall be divided into various categories, viz. major experiment, minor experiment, spotters, etc. as per the requirement of the course.

Internal assessment: The marks secured by the students out of the total of 80 shall be reduced to 10 in each sessional, and then the internal assessment shall be calculated based on the best two averages for 10 marks from the sessional and other 10 marks shall be awarded as per the details given below.

Actual performance in the sessional examination	= 10 marks
Assignment marks (Average of three)	= 5 marks*
Field Visit Report marks (Average for the reports)	= 5 marks$

Total	= 20 marks
	---

*, $ Only for the courses given with both assignments and field visit/s

Note:

1. For the courses having either assignments or field visit/s, the assessments of assignments or field visit/s shall be done directly for 10 marks and added to the sessional marks.
2. For the courses not having both assignment and field visit, the whole 20 marks shall be calculated from the sessional marks.

Final Board / University Examinations

The scheme of the question paper for the practical examinations conducted by the examining authority (Board / University) shall be as given below. The duration of the final examination shall be 3 hours.

I. Synopsis	=	10
II. Experiments	=	60*
III. Viva voce	=	10

Total	=	80 marks

***** The marks for the experiments shall be divided into various categories, viz. major experiment, minor experiment, spotters, etc. as per the requirement of the course.

7. ER-2020 D.Pharm Syllabus – Part I

S. No.	Course Code	Name of the Course	Total Theory / Practical Hours	Total Tutorial Hours	Theory / Practical Hours per Week	Tutorial Hours per Week
1.	ER20-11T	Pharmaceutics – Theory	75	25	3	1
2.	ER20-11P	Pharmaceutics – Practical	75	-	3	-
3.	ER20-12T	Pharmaceutical Chemistry – Theory	75	25	3	1
4.	ER20-12P	Pharmaceutical Chemistry – Practical	75	-	3	-
5.	ER20-13T	Pharmacognosy – Theory	75	25	3	1
6.	ER20-13P	Pharmacognosy – Practical	75	-	3	-
7.	ER20-14T	Human Anatomy & Physiology – Theory	75	25	3	1
8.	ER20-14P	Human Anatomy & Physiology – Practical	75	-	3	-
9.	ER20-15T	Social Pharmacy – Theory	75	25	3	1
10.	ER20-15P	Social Pharmacy – Practical	75	-	3	-

PHARMACEUTICS – THEORY

Course Code: ER20-11T **75 Hours (3 Hours/week)**

Scope: This course is designed to impart basic knowledge and skills on the art and science of formulating and dispensing different pharmaceutical dosage forms.

Course Objectives: This course will discuss the following aspects of pharmaceutical dosage forms

1. Basic concepts, types and need
2. Advantages and disadvantages, methods of preparation / formulation
3. Packaging and labelling requirements
4. Basic quality control tests, concepts of quality assurance and good manufacturing practices

Course Outcomes: Upon successful completion of this course, the students will be able to

1. Describe about the different dosage forms and their formulation aspects
2. Explain the advantages, disadvantages, and quality control tests of different dosage forms
3. Discuss the importance of quality assurance and good manufacturing practices

Chapter	Topics	Hours
1	• History of the profession of Pharmacy in India in relation to Pharmacy education, industry, pharmacy practice, and various professional associations. • Pharmacy as a career • Pharmacopoeia: Introduction to IP, BP, USP, NF and Extra Pharmacopoeia. Salient features of Indian Pharmacopoeia	7
2	**Packaging materials**: Types, selection criteria, advantages and disadvantages of glass, plastic, metal, rubber as packaging materials	5
3	**Pharmaceutical aids:** Organoleptic (Colouring, flavouring, and sweetening) agents **Preservatives:** Definition, types with examples and uses	3
4	**Unit operations:** Definition, objectives/applications, principles, construction, and workings of:	9
	Size reduction: hammer mill and ball mill	
	Size separation: Classification of powders according to IP, Cyclone separator, Sieves and standards of sieves	

	Mixing: Double cone blender, Turbine mixer, Triple roller mill and Silverson mixer homogenizer	
	Filtration: Theory of filtration, membrane filter and sintered glass filter	
	Drying: working of fluidized bed dryer and process of freeze drying	
	Extraction: Definition, Classification, method, and applications	
5	**Tablets** – coated and uncoated, various modified tablets (sustained release, extended-release, fast dissolving, multi-layered, etc.)	**8**
	Capsules - hard and soft gelatine capsules	**4**
	Liquid oral preparations - solution, syrup, elixir, emulsion, suspension, dry powder for reconstitution	**6**
	Topical preparations - ointments, creams, pastes, gels, liniments and lotions, suppositories, and pessaries	**8**
	Nasal preparations, Ear preparations	**2**
	Powders and granules - Insufflations, dusting powders, effervescent powders, and effervescent granules	**3**
	Sterile formulations – Injectables, eye drops and eye ointments	**6**
	Immunological products: Sera, vaccines, toxoids, and their manufacturing methods.	**4**
6	**Basic structure, layout, sections, and activities of pharmaceutical manufacturing plants** **Quality control and quality assurance**: Definition and concepts of quality control and quality assurance, current good manufacturing practice (cGMP), Introduction to the concept of calibration and validation	**5**
7	**Novel drug delivery systems:** Introduction, Classification with examples, advantages, and challenges	**5**

PHARMACEUTICS – PRACTICAL

Course Code: ER20-11P **75 Hours (3 Hours/week)**

Scope: This course is designed to train the students in formulating and dispensing common pharmaceutical dosage forms.

Course Objectives: This course will discuss and train the following aspects of preparing and dispensing various pharmaceutical dosage forms

1. Calculation of working formula from the official master formula

2. Formulation of dosage forms based on working formula
3. Appropriate Packaging and labelling requirements
4. Methods of basic quality control tests

Course Outcomes: Upon successful completion of this course, the students will be able to

1. Calculate the working formula from the given master formula
2. Formulate the dosage form and dispense in an appropriate container
3. Design the label with the necessary product and patient information
4. Perform the basic quality control tests for the common dosage forms

Practicals

1. Handling and referring the official references: Pharmacopoeias, Formularies, etc. for retrieving formulas, procedures, etc.

2. Formulation of the following dosage forms as per monograph standards and dispensing with appropriate packaging and labelling
   - **Liquid Oral:** Simple syrup, Piperazine citrate elixir, Aqueous Iodine solution
   - **Emulsion:** Castor oil emulsion, Cod liver oil emulsion
   - **Suspension:** Calamine lotion, Magnesium hydroxide mixture
   - **Ointment:** Simple ointment base, Sulphur ointment
   - **Cream:** Cetrimide cream
   - **Gel:** Sodium alginate gel
   - **Liniment:** Turpentine liniment, White liniment BPC
   - **Dry powder:** Effervescent powder granules, Dusting powder
   - **Sterile Injection:** Normal Saline, Calcium gluconate Injection
   - **Hard Gelatine Capsule:** Tetracycline capsules
   - **Tablet:** Paracetamol tablets
3. Formulation of at least five commonly used cosmetic preparations – e.g. cold cream, shampoo, lotion, toothpaste etc

4. Demonstration on various stages of tablet manufacturing processes

5. Appropriate methods of usage and storage of all dosage forms including special dosage such as different types of inhalers, spacers, insulin pens
6. Demonstration of quality control tests and evaluation of common dosage forms viz. tablets, capsules, emulsion, sterile injections as per the monographs

Assignments

The students shall be asked to submit written assignments on the following topics (One assignment per student per sessional period. i.e., a minimum of THREE assignments per student)

1. Various systems of measures commonly used in prescribing, compounding and dispensing practices
2. Market preparations (including Fixed Dose Combinations) of each type of dosage forms, their generic name, minimum three brand names and label contents of the dosage forms mentioned in theory/practical
3. Overview of various machines / equipment~~s~~ / instruments involved in the formulation and quality control of various dosage forms / pharmaceutical formulations.
4. Overview of extemporaneous preparations at community / hospital pharmacy vs. manufacturing of dosage forms at industrial level
5. Basic pharmaceutical calculations: ratios, conversion to percentage fraction, alligation, proof spirit, isotonicity

Field Visit

The students shall be taken for an industrial visit to pharmaceutical industries to witness and understand the various processes of manufacturing of any of the common dosage forms viz. tablets, capsules, liquid orals, injectables, etc. Individual reports from each student on their learning experience from the field visit shall be submitted.

PHARMACEUTICAL CHEMISTRY – THEORY

Course Code: ER20-12T **75 Hours (3 Hours/week)**

Scope: This course is designed to impart basic knowledge on the chemical structure, storage conditions and medicinal uses of organic and inorganic chemical substances used as drugs and pharmaceuticals. Also, this course discusses the impurities, quality control aspects of chemical substances used in pharmaceuticals.

Course Objectives: This course will discuss the following aspects of the chemical substances used as drugs and pharmaceuticals for various disease conditions

1. Chemical classification, chemical name, chemical structure
2. Pharmacological uses, doses, stability and storage conditions
3. Different types of formulations / dosage form available and their brand names
4. Impurity testing and basic quality control tests

Course Outcomes: Upon successful completion of this course, the students will be able to

1. Describe the chemical class, structure and chemical name of the commonly used drugs and pharmaceuticals of both organic and inorganic nature
2. Discuss the pharmacological uses, dosage regimen, stability issues and storage conditions of all such chemical substances commonly used as drugs
3. Describe the quantitative and qualitative analysis, impurity testing of the chemical substances given in the official monographs
4. Identify the dosage form & the brand names of the drugs and pharmaceuticals popular in the marketplace

Chapter	Topic	Hours
1	**Introduction to Pharmaceutical chemistry:** Scope and objectives **Sources and types of errors:** Accuracy, precision, significant figures **Impurities in Pharmaceuticals**: Source and effect of impurities in Pharmacopoeial substances, importance of limit test, Principle and procedures of Limit tests for chlorides, sulphates, iron, heavy metals and arsenic.	8
2	**Volumetric analysis**: Fundamentals of volumetric analysis, Acid-base titration, non-aqueous titration, precipitation titration, complexometric titration, redox titration **Gravimetric analysis:** Principle and method.	8

3	**Inorganic Pharmaceuticals**: Pharmaceutical formulations, market preparations, storage conditions and uses of ● **Haematinics:** Ferrous sulphate, Ferrous fumarate, Ferric ammonium citrate, Ferrous ascorbate, Carbonyl iron ● **Gastro-intestinal Agents:** Antacids :Aluminium hydroxide gel, Magnesium hydroxide, Magaldrate, Sodium bicarbonate, Calcium Carbonate, Acidifying agents, Adsorbents, Protectives, Cathartics ● **Topical agents:** Silver Nitrate, Ionic Silver, Chlorhexidine Gluconate, Hydrogen peroxide, Boric acid, Bleaching powder, Potassium permanganate ● **Dental products:** Calcium carbonate, Sodium fluoride, Denture cleaners, Denture adhesives, Mouth washes ● **Medicinal gases:** Carbon dioxide, nitrous oxide, oxygen	**7**
4	Introduction to nomenclature of organic chemical systems with particular reference to heterocyclic compounds containing up to Three rings	**2**
Study of the following category of medicinal compounds with respect to classification, chemical name, chemical structure (compounds marked with*) uses, stability and storage conditions, different types of formulations and their popular brand names		
5	**Drugs Acting on Central Nervous System** ● **Anaesthetics:** Thiopental Sodium*, Ketamine Hydrochloride*, Propofol ● **Sedatives and Hypnotics:** Diazepam*, Alprazolam*, Nitrazepam, Phenobarbital* ● **Antipsychotics:** Chlorpromazine Hydrochloride*, Haloperidol*, Risperidone*, Sulpiride*, Olanzapine, Quetiapine, Lurasidone ● **Anticonvulsants:** Phenytoin*, Carbamazepine*, Clonazepam, Valproic Acid*, Gabapentin*, Topiramate, Vigabatrin, Lamotrigine ● **Anti-Depressants:** Amitriptyline Hydrochloride*, Imipramine Hydrochloride*, Fluoxetine*, Venlafaxine, Duloxetine, Sertraline, Citalopram, Escitalopram, Fluvoxamine, Paroxetine	**9**
6	**Drugs Acting on Autonomic Nervous System** ● **Sympathomimetic Agents:** ***Direct Acting:*** Nor-Epinephrine*, Epinephrine, Phenylephrine,	**9**

	Dopamine*, Terbutaline, Salbutamol (Albuterol), Naphazoline*, Tetrahydrozoline. ***Indirect Acting Agents:*** Hydroxy Amphetamine, Pseudoephedrine. Agents With Mixed Mechanism**:** Ephedrine, Metaraminol ● **Adrenergic Antagonists:** Alpha Adrenergic Blockers: Tolazoline, Phentolamine ● Phenoxybenzamine, Prazosin. Beta Adrenergic Blockers: Propranolol*, Atenolol*, Carvedilol ● **Cholinergic Drugs and Related Agents:** Direct Acting Agents: Acetylcholine*, Carbachol, And Pilocarpine. Cholinesterase Inhibitors: Neostigmine*, Edrophonium Chloride, Tacrine Hydrochloride, Pralidoxime Chloride, Echothiopate Iodide ● **Cholinergic Blocking Agents:** Atropine Sulphate*, Ipratropium Bromide ***Synthetic Cholinergic Blocking Agents***: Tropicamide, Cyclopentolate Hydrochloride, Clidinium Bromide, Dicyclomine Hydrochloride*	
7	**Drugs Acting on Cardiovascular System** ● **Anti-Arrhythmic Drugs**: Quinidine Sulphate, Procainamide Hydrochloride, Verapamil, Phenytoin Sodium*, Lidocaine Hydrochloride, Lorcainide Hydrochloride, Amiodarone and Sotalol ● **Anti-Hypertensive Agents**: Propranolol*, Captopril*, Ramipril, Methyldopate Hydrochloride, Clonidine Hydrochloride, Hydralazine Hydrochloride, Nifedipine, ● **Antianginal Agents**: Isosorbide Dinitrate	**5**
8	**Diuretics:** Acetazolamide, Frusemide*, Bumetanide, Chlorthalidone, Benzthiazide, Metolazone, Xipamide, Spironolactone	**2**
9	**Hypoglycemic Agents:** Insulin and Its Preparations, Metformin*, Glibenclamide*, Glimepiride, Pioglitazone, Repaglinide, Gliflozins, Gliptins	**3**
10	**Analgesic And Anti-Inflammatory Agents:** Morphine Analogues, Narcotic Antagonists; ***Nonsteroidal Anti-Inflammatory Agents (NSAIDs)*** - Aspirin*, Diclofenac, Ibuprofen*, Piroxicam, Celecoxib, Mefenamic Acid, Paracetamol*, Aceclofenac	**3**
11	**Anti-Infective Agents** ● **Antifungal Agents:** Amphotericin-B, Griseofulvin, Miconazole, Ketoconazole*, Itraconazole, Fluconazole*, Naftifine Hydrochloride	**8**

	● **Urinary Tract Anti-Infective Agents:** Norfloxacin, Ciprofloxacin, Ofloxacin*, Moxifloxacin, ● **Anti-Tubercular Agents:** INH*, Ethambutol, Para Amino Salicylic Acid, Pyrazinamide, Rifampicin, Bedaquiline, Delamanid, Pretomanid* ● **Antiviral Agents:** Amantadine Hydrochloride, Idoxuridine, Acyclovir*, Foscarnet, Zidovudine, Ribavirin, Remdesivir, Favipiravir ● **Antimalarials:** Quinine Sulphate, Chloroquine Phosphate*, Primaquine Phosphate, Mefloquine*, Cycloguanil, Pyrimethamine, Artemisinin ● **Sulfonamides:** Sulfanilamide, Sulfadiazine, Sulfametho xazole, Sulfacetamide*, Mafenide Acetate, Cotrimoxazole, Dapsone*	
12	**Antibiotics:** Penicillin G, Amoxicillin*, Cloxacillin, Streptomycin, ***Tetracyclines:*** Doxycycline, Minocycline, ***Macrolides:*** Erythromycin, Azithromycin, ***Miscellaneous:*** Chloramphenicol* Clindamycin	**8**
13	**Anti-Neoplastic Agents:** Cyclophosphamide*, Busulfan, Mercaptopurine, Fluorouracil*, Methotrexate, Dactinomycin, Doxorubicin Hydrochloride, Vinblastine Sulphate, Cisplatin*, Dromostanolone Propionate	**3**

PHARMACEUTICAL CHEMISTRY – PRACTICAL

Course Code: ER20-12P **75 Hours (3 Hours/week)**

Scope: This course is designed to impart basic training and hands-on experiences to synthesis chemical substances used as drugs and pharmaceuticals. Also, to perform the quality control tests, impurity testing, test for purity and systematic qualitative analysis of chemical substances used as drugs and pharmaceuticals.

Course Objectives: This course will provide the hands-on experience on the following aspects of chemical substances used as drugs and pharmaceuticals

1. Limit tests and assays of selected chemical substances as per the monograph
2. Volumetric analysis of the chemical substances
3. Basics of preparatory chemistry and their analysis
4. Systematic qualitative analysis for the identification of the chemical drugs

Course Outcomes: Upon successful completion of this course, the students will be able to

1. Perform the limit tests for various inorganic elements and report
2. Prepare standard solutions using the principles of volumetric analysis
3. Test the purity of the selected inorganic and organic compounds against the monograph standards
4. Synthesize the selected chemical substances as per the standard synthetic scheme
5. Perform qualitative tests to systematically identify the unknown chemical substances

Practicals

S. No.	Experiment
1	**Limit test for** ● Chlorides; sulphate; Iron; heavy metals
2	Identification tests for Anions and Cations as per Indian Pharmacopoeia
3	**Fundamentals of Volumetric analysis** Preparation of standard solution and standardization of Sodium Hydroxide, Potassium Permanganate
4	**Assay of the following compounds** ● Ferrous sulphate- by redox titration ● Calcium gluconate-by complexometric ● Sodium chloride-by Modified Volhard's method ● Ascorbic acid by iodometry ● Ibuprofen by alkalimetry
5	**Fundamentals of preparative organic chemistry** Determination of Melting point and boiling point of organic compounds
6	**Preparation of organic compounds** • Benzoic acid from Benzamide • Picric acid from Phenol
7	**Identification and test for purity of pharmaceuticals** Aspirin, Caffeine, Paracetamol, Sulfanilamide
8	Systematic Qualitative analysis experiments (4 substances)

Assignments

The students shall be asked to submit the written assignments on the following topics (One assignment per student per sessional period. i.e., a minimum of THREE assignments per student)

1. Different monographs and formularies available and their major contents
2. Significance of quality control and quality assurance in pharmaceutical industries
3. Overview on Green Chemistry
4. Various software programs available for computer aided drug discovery
5. Various instrumentations used for characterization and quantification of drug

PHARMACOGNOSY – THEORY

Course Code: ER20-13T **75 Hours (3 Hours/week)**

Scope: This course is designed to impart knowledge on the medicinal uses of various drugs of natural origin. Also, the course emphasizes the fundamental concepts in the evaluation of crude drugs, alternative systems of medicine, nutraceuticals, and herbal cosmetics.

Course Objectives: This course will discuss the following aspects of drug substances derived from natural resources.

1. Occurrence, distribution, isolation, identification tests of common phytoconstituents
2. Therapeutic activity and pharmaceutical applications of various natural drug substances and phytoconstituents
3. Biological source, chemical constituents of selected crude drugs and their therapeutic efficacy in common diseases and ailments
4. Basic concepts in quality control of crude drugs and various system of medicines
5. Applications of herbs in health foods and cosmetics

Course Outcomes: Upon successful completion of this course, the students will be able to

1. Identify the important/common crude drugs of natural origin
2. Describe the uses of herbs in nutraceuticals and cosmeceuticals
3. Discuss the principles of alternative system of medicines
4. Describe the importance of quality control of drugs of natural origin

Chapter	Topic	Hours
1	Definition, history, present status and scope of Pharmacognosy	**2**
2	**Classification of drugs:** ● Alphabetical ● Taxonomical ● Morphological ● Pharmacological ● Chemical ● Chemo-taxonomical	**4**
3	**Quality control of crude drugs:** ● Different methods of adulteration of crude drugs ● Evaluation of crude drugs	**6**

<table>
<tr><td>4</td><td colspan="2">Brief outline of occurrence, distribution, isolation, identification tests, therapeutic activity and pharmaceutical applications of alkaloids, terpenoids, glycosides, volatile oils, tannins and resins.</td><td>6</td></tr>
<tr><td rowspan="18">5</td><td colspan="2">Biological source, chemical constituents and therapeutic efficacy of the following categories of crude drugs.</td><td rowspan="18">30</td></tr>
<tr><td>Laxatives</td><td>Aloe, Castor oil, Ispaghula, Senna</td></tr>
<tr><td>Cardiotonic</td><td>Digitalis, Arjuna</td></tr>
<tr><td>Carminatives and G.I. regulators</td><td>Coriander, Fennel, Cardamom, Ginger, Clove, Black Pepper, Asafoetida, Nutmeg, Cinnamon</td></tr>
<tr><td>Astringents</td><td>Myrobalan, Black Catechu, Pale Catechu</td></tr>
<tr><td>Drugs acting on nervous system</td><td>Hyoscyamus, Belladonna, Ephedra, Opium, Tea leaves, Coffee seeds, Coca</td></tr>
<tr><td>Anti-hypertensive</td><td>Rauwolfia</td></tr>
<tr><td>Anti-tussive</td><td>Vasaka, Tolu Balsam</td></tr>
<tr><td>Anti-rheumatics</td><td>Colchicum seed</td></tr>
<tr><td>Anti-tumour</td><td>Vinca, Podophyllum</td></tr>
<tr><td>Antidiabetics</td><td>Pterocarpus, Gymnema</td></tr>
<tr><td>Diuretics</td><td>Gokhru, Punarnava</td></tr>
<tr><td>Anti-dysenteric</td><td>Ipecacuanha</td></tr>
<tr><td>Antiseptics and disinfectants</td><td>Benzoin, Myrrh, Neem, Turmeric</td></tr>
<tr><td>Antimalarials</td><td>Cinchona, Artemisia</td></tr>
<tr><td>Oxytocic</td><td>Ergot</td></tr>
<tr><td>Vitamins</td><td>Cod liver oil, Shark liver oil</td></tr>
<tr><td>Enzymes</td><td>Papaya, Diastase, Pancreatin, Yeast</td></tr>
<tr><td>Pharmaceutical Aids</td><td>Kaolin, Lanolin, Beeswax, Acacia, Tragacanth, Sodium alginate, Agar, Guar gum, Gelatine</td></tr>
<tr><td>Miscellaneous</td><td>Squill, Galls, Ashwagandha, Tulsi, Guggul</td></tr>
<tr><td>6</td><td colspan="2">Plant fibres used as surgical dressings: Cotton, silk, wool and regenerated fibres
Sutures – Surgical Catgut and Ligatures</td><td>3</td></tr>
<tr><td>7</td><td colspan="2">● Basic principles involved in the traditional systems of medicine like: Ayurveda, Siddha, Unani and Homeopathy

● Method of preparation of Ayurvedic formulations like: Arista, Asava, Gutika, Taila, Churna, Lehya and Bhasma</td><td>8</td></tr>
</table>

8	Role of medicinal and aromatic plants in national economy and their export potential	**2**
9	**Herbs as health food:** Brief introduction and therapeutic applications of: Nutraceuticals, Antioxidants, Pro-biotics, Pre-biotics, Dietary fibres, Omega-3-fatty acids, Spirulina, Carotenoids, Soya and Garlic	**4**
10	Introduction to herbal formulations	**4**
11	**Herbal cosmetics:** Sources, chemical constituents, commercial preparations, therapeutic and cosmetic uses of: Aloe vera gel, Almond oil, Lavender oil, Olive oil, Rosemary oil, Sandal Wood oil	**4**
12	Phytochemical investigation of drugs	**2**

PHARMACOGNOSY – PRACTICAL

Course Code: ER20-13P **75 Hours (3 Hours/week)**

Scope: This course is designed to train the students in physical identification, morphological characterization, physical and chemical characterization, and evaluation of commonly used herbal drugs.

Course Objectives: This course will provide hands-on experiences to the students in

1. Identification of the crude drugs based on their morphological characteristics
2. Various characteristic anatomical characteristics of the herbal drugs studied through transverse section
3. Physical and chemical tests to evaluate the crude drugs

Course Outcomes: Upon successful completion of this course, the students will be able to

1. Identify the given crude drugs based on the morphological characteristics
2. Take a transverse section of the given crude drugs
3. Describe the anatomical characteristics of the given crude drug under microscopical conditions
4. Carry out the physical and chemical tests to evaluate the given crude drugs

Practicals

1. Morphological Identification of the following drugs:
Ispaghula, Senna, Coriander, Fennel, Cardamom, Ginger, Nutmeg, Black Pepper, Cinnamon, Clove, Ephedra, Rauwolfia, Gokhru, Punarnava, Cinchona, Agar.

2. Gross anatomical studies (Transverse Section) of the following drugs:
Ajwain, Datura, Cinnamon, Cinchona, Coriander, Ashwagandha, Liquorice, Clove, Curcuma, Nux vomica, Vasaka

3. Physical and chemical tests for evaluation of any FIVE of the following drugs:
Asafoetida, Benzoin, Pale catechu, Black catechu, Castor oil, Acacia, Tragacanth, Agar, Guar gum, Gelatine.

Assignments

The students shall be asked to submit the written assignments on the following topics (One assignment per student per sessional period. i.e., a minimum of THREE assignments per student)

1. Market preparations of various dosage forms of Ayurvedic, Unani, Siddha, Homeopathic (Classical and Proprietary), indications, and their labelling requirements
2. Market preparations of various herbal formulations and herbal cosmetics, indications, and their labelling requirements
3. Herb-Drug interactions documented in the literature and their clinical significances

Field Visit

The students shall be taken in groups to a medicinal garden to witness and understand the nature of various medicinal plants discussed in theory and practical courses. Additionally, they shall be taken in groups to the pharmacies of traditional systems of medicines to understand the availability of various dosage forms and their labelling requirements. Individual reports from each student on their learning experience from the field visit shall be submitted.

HUMAN ANATOMY AND PHYSIOLOGY – THEORY

Course Code: ER20-14T **75 Hours (3 Hours/week)**

Scope: This course is designed to impart basic knowledge on the structure and functions of the human body. It helps in understanding both homeostasis mechanisms and homeostatic imbalances of various systems of the human body.

Course Objectives: This course will discuss the following:

1. Structure and functions of the various organ systems and organs of the human body
2. Homeostatic mechanisms and their imbalances in the human body
3. Various vital physiological parameters of the human body and their significances

Course Outcomes: Upon successful completion of this course, the students will be able to

1. Describe the various organ systems of the human body
2. Discuss the anatomical features of the important human organs and tissues
3. Explain the homeostatic mechanisms regulating the normal physiology in the human system
4. Discuss the significance of various vital physiological parameters of the human body

Chapter	Topic	Hours
1	Scope of Anatomy and Physiology Definition of various terminologies	**2**
2	**Structure of Cell**: Components and its functions	**2**
3	**Tissues of the human body**: Epithelial, Connective, Muscular and Nervous tissues – their sub-types and characteristics.	**4**
4	**Osseous system**: structure and functions of bones of axial and appendicular skeleton Classification, types and movements of joints, disorders of joints	**3** **3**
5	**Haemopoietic system** ● Composition and functions of blood ● Process of Hemopoiesis ● Characteristics and functions of RBCs, WBCs, and platelets ● Mechanism of Blood Clotting ● Importance of Blood groups	**8**

6	**Lymphatic system** ● Lymph and lymphatic system, composition, function and its formation. ● Structure and functions of spleen and lymph node.	**3**
7	**Cardiovascular system** ● Anatomy and Physiology of heart ● Blood vessels and circulation (Pulmonary, coronary and systemic circulation) ● Cardiac cycle and Heart sounds, Basics of ECG ● Blood pressure and its regulation	**8**
8	**Respiratory system** ● Anatomy of respiratory organs and their functions. ● Regulation, and Mechanism of respiration. ● Respiratory volumes and capacities – definitions	**4**
9	**Digestive system** ● Anatomy and Physiology of the GIT ● Anatomy and functions of accessory glands ● Physiology of digestion and absorption	**8**
10	**Skeletal muscles** ● Histology ● Physiology of muscle contraction ● Disorder of skeletal muscles	**2**
11	**Nervous system** ● Classification of nervous system ● Anatomy and physiology of cerebrum, cerebellum, mid brain ● Function of hypothalamus, medulla oblongata and basal ganglia ● Spinal cord-structure and reflexes ● Names and functions of cranial nerves. ● Anatomy and physiology of sympathetic and parasympathetic nervous system (ANS)	**8**
12	**Sense organs - Anatomy and physiology of** ● Eye ● Ear ● Skin ● Tongue ● Nose	**6**
13	**Urinary system** ● Anatomy and physiology of urinary system ● Physiology of urine formation ● Renin - angiotensin system ● Clearance tests and micturition	**4**

14	**Endocrine system (Hormones and their functions)** ● Pituitary gland ● Adrenal gland ● Thyroid and parathyroid gland ● Pancreas and gonads	**6**
15	**Reproductive system** ● Anatomy of male and female reproductive system ● Physiology of menstruation ● Spermatogenesis and Oogenesis ● Pregnancy and parturition	**4**

HUMAN ANATOMY AND PHYSIOLOGY – PRACTICAL

Course Code: ER20-14P **75 Hours (3 Hours/week)**

Scope: This course is designed to train the students and instil the skills for carrying out basic physiological monitoring of various systems and functions.

Course Objectives: This course will provide hands-on experience in the following:

1. General blood collection techniques and carrying out various haematological assessments and interpreting the results
2. Recording and monitoring the vital physiological parameters in human subjects and the basic interpretations of the results
3. Microscopic examinations of the various tissues permanently mounted in glass slides
4. Discuss the anatomical and physiological characteristics of various organ systems of the body using models, charts, and other teaching aids

Course Outcomes: Upon successful completion of this course, the students will be able to

1. Perform the haematological tests in human subjects and interpret the results
2. Record, monitor and document the vital physiological parameters of human subjects and interpret the results
3. Describe the anatomical features of the important human tissues under the microscopical conditions
4. Discuss the significance of various anatomical and physiological characteristics of the human body

Practicals

1. Study of compound microscope
2. General techniques for the collection of blood
3. Microscopic examination of Epithelial tissue, Cardiac muscle, Smooth muscle, Skeletal muscle, Connective tissue, and Nervous tissue of ready / pre-prepared slides.
4. Study of Human Skeleton-Axial skeleton and appendicular skeleton
5. Determination of
    a. Blood group
    b. ESR
    c. Haemoglobin content of blood
    d. Bleeding time and Clotting time
6. Determination of WBC count of blood
7. Determination of RBC count of blood
8. Determination of Differential count of blood
9. Recording of Blood Pressure in various postures, different arms, before and after exertion and interpreting the results
10. Recording of Body temperature (using mercury, digital and IR thermometers at various locations), Pulse rate/ Heart rate (at various locations in the body, before and after exertion), Respiratory Rate
11. Recording Pulse Oxygen (before and after exertion)
12. Recording force of air expelled using Peak Flow Meter
13. Measurement of height, weight, and BMI
14. Study of various systems and organs with the help of chart, models, and specimens
    a) Cardiovascular system
    b) Respiratory system
    c) Digestive system
    d) Urinary system
    e) Endocrine system
    f) Reproductive system
    g) Nervous system
    h) Eye
    i) Ear
    j) Skin

SOCIAL PHARMACY – THEORY

Course Code: ER20-15T **75 Hours (3 Hours/week)**

Scope: This course is designed to impart basic knowledge on public health, epidemiology, preventive care, and other social health related concepts. Also, to emphasize the roles of pharmacists in the public health programs.

Course Objectives: This course will discuss about basic concepts of

1. Public health and national health programs
2. Preventive healthcare
3. Food and nutrition related health issues
4. Health education and health promotion
5. General roles and responsibilities of pharmacists in public health

Course Outcomes: Upon successful completion of this course, the students will be able to

1. Discuss about roles of pharmacists in the various national health programs
2. Describe various sources of health hazards and disease preventive measures
3. Discuss the healthcare issues associated with food and nutritional substances
4. Describe the general roles and responsibilities of pharmacists in public health

Chapter	Topic	Hours
1	**Introduction to Social Pharmacy** • Definition and Scope. Social Pharmacy as a discipline and its scope in improving the public health. Role of Pharmacists in Public Health. (2) • Concept of Health -WHO Definition, various dimensions, determinants, and health indicators. (3) • National Health Policy – Indian perspective (1) • Public and Private Health System in India, National Health Mission (2) • Introduction to Millennium Development Goals, Sustainable Development Goals, FIP Development Goals (1)	9
2	**Preventive healthcare – Role of Pharmacists in the following** • Demography and Family Planning (3) • Mother and child health, importance of breastfeeding, ill effects of infant milk substitutes and bottle feeding (2) • Overview of Vaccines, types of immunity and immunization (4)	18

	• Effect of Environment on Health – Water pollution, importance of safe drinking water, waterborne diseases, air pollution, noise pollution, sewage and solid waste disposal, occupational illnesses, Environmental pollution due to pharmaceuticals (7) • Psychosocial Pharmacy: Drugs of misuse and abuse – psychotropics, narcotics, alcohol, tobacco products. Social Impact of these habits on social health and productivity and suicidal behaviours (2)	
3	**Nutrition and Health** • Basics of nutrition – Macronutrients and Micronutrients (3) • Importance of water and fibres in diet (1) • Balanced diet, Malnutrition, nutrition deficiency diseases, ill effects of junk foods, calorific and nutritive values of various foods, fortification of food (3) • Introduction to food safety, adulteration of foods, effects of artificial ripening, use of pesticides, genetically modified foods (1) • Dietary supplements, nutraceuticals, food supplements – indications, benefits, Drug-Food Interactions (2)	**10**
4	Introduction to Microbiology and common microorganisms (3) **Epidemiology:** Introduction to epidemiology, and its applications. Understanding of terms such as epidemic, pandemic, endemic, mode of transmission, outbreak, quarantine, isolation, incubation period, contact tracing, morbidity, mortality, . (2) Causative agents, epidemiology and clinical presentations and Role of Pharmacists in educating the public in prevention of the following communicable diseases: • Respiratory infections – chickenpox, measles, rubella, mumps, influenza (including Avian-Flu, H1N1, SARS, MERS, COVID-19), diphtheria, whooping cough, meningococcal meningitis, acute respiratory infections, tuberculosis, Ebola (7) • Intestinal infections – poliomyelitis, viral hepatitis, cholera, acute diarrheal diseases, typhoid, amebiasis, worm infestations, food poisoning (7)	**28**

	• Arthropod-borne infections - dengue, malaria, filariasis and, chikungunya (4) • Surface infections – trachoma, tetanus, leprosy (2) • STDs, HIV/AIDS (3)	
5	Introduction to health systems and **all ongoing National Health programs** in India, their objectives, functioning, outcome, and the role of pharmacists.	**8**
6	**Pharmacoeconomics** – Introduction, basic terminologies, importance of pharmacoeconomics	**~~2~~**

SOCIAL PHARMACY – PRACTICAL

Course Code: ER20-15P **75 Hours (3 Hours/week)**

Scope: This course is designed to provide simulated experience in various public health and social pharmacy activities.

Course Objectives: This course will train the students on various roles of pharmacists in public health and social pharmacy activities in the following areas:

1. National immunization programs
2. Reproductive and child health programs
3. Food and nutrition related health programs
4. Health education and promotion
5. General roles and responsibilities of the pharmacists in public health
6. First Aid for various emergency conditions including basic life support and cardiopulmonary resuscitation

Course Outcomes: Upon successful completion of this course, the students will be able to

1. Describe the roles and responsibilities of pharmacists in various National health programs
2. Design promotional materials for public health awareness
3. Describe various health hazards including microbial sources
4. Advice on preventive measures for various diseases
5. Provide first aid for various emergency conditions

Note: Demonstration / Hands-on experience / preparation of charts / models / promotional materials / role plays / enacting / e-brochures / e-flyers / podcasts / video podcasts / any other innovative activities to understand the concept of various elements of social pharmacy listed here. (At least one activity to be carried out for each one of the following):

Practicals

1. National immunization schedule for children, adult vaccine schedule, Vaccines which are not included in the National Immunization Program.
2. RCH – reproductive and child health – nutritional aspects, relevant national health programmes.
3. Family planning devices
4. Microscopical observation of different microbes (readymade slides)
5. Oral Health and Hygiene
6. Personal hygiene and etiquettes – hand washing techniques, Cough and sneeze etiquettes.
7. Various types of masks, PPE gear, wearing/using them, and disposal.
8. Menstrual hygiene, products used
9. First Aid – Theory, basics, demonstration, hands on training, audio-visuals, and practice, BSL (Basic Life Support) Systems [SCA - Sudden Cardiac Arrest, FBAO - Foreign Body Airway Obstruction, CPR, Defibrillation (using AED) (Includes CPR techniques, First Responder).
10. Emergency treatment for all medical emergency cases viz. snake bite, dog bite, insecticide poisoning, fractures, burns, epilepsy etc.
11. Role of Pharmacist in Disaster Management.
12. Marketed preparations of disinfectants, antiseptics, fumigating agents, antilarval agents, mosquito repellents, etc.
13. Health Communication: Audio / Video podcasts, Images, Power Point Slides, Short Films, etc. in regional language(s) for mass communication / education / Awareness on 5 different communicable diseases, their signs and symptoms, and prevention.
14. Water purification techniques, use of water testing kit, calculation of Content/percentage of $KMnO_4$, bleaching powder to be used for wells/tanks
15. Counselling children on junk foods, balanced diets – using Information, Education and Communication (IEC), counselling, etc. (Simulation Experiments).
16. Preparation of various charts on nutrition, sources of various nutrients from Locally available foods, calculation of caloric needs of different groups (e.g. child, mother, sedentary lifestyle, etc.). Chart of glycemic index of foods.
17. Tobacco cessation, counselling, identifying various tobacco containing products through charts/pictures

Assignment

The students shall be asked to submit the written assignments on the following topics (One assignment per student per sessional period. i.e., a minimum of THREE assignments per student)

1. An overview of Women's Health Issues
2. Study the labels of various packed foods to understand their nutritional contents
3. Breastfeeding counselling, guidance – using Information, Education and Communication (IEC)
4. Information about the organizations working on de-addiction services in the region (city / district, etc.)
5. Role of a pharmacist in disaster management – A case study
6. Overview on the National Tuberculosis Elimination Programme (NTEP)
7. Drug disposal systems in the country, at industry level and citizen level
8. Various Prebiotics or Probiotics (dietary and market products)
9. Emergency preparedness: Study of local Government structure with respect to Fire, Police departments, health department
10. Prepare poster/presentation for general public on any one of the Health Days. e.g. Day, AIDS Day, Handwashing Day, ORS day, World Diabetes Day, World Heart Day, etc.
11. List of home medicines, their storage, safe handling, and disposal of unused medicines
12. Responsible Use of Medicines: From Purchase to Disposal
13. Collection of newspaper clips (minimum 5) relevant to any one topic and its submission in an organized form with collective summary based on the news items
14. Read a minimum of one article relevant to any theory topic, from Pharma /Science/ or other Periodicals and prepare summary of it for submission
15. Potential roles of pharmacists in rural India

Field Visits

The students shall be taken in groups to visit any THREE of the following facilities to witness and understand the activities of such centres/facilities from the perspectives of the topics discussed in theory and/or practical courses. Individual reports from each student on their learning experience from the field visits shall be submitted.

1. Garbage Treatment Plant
2. Sewage Treatment Plant
3. Bio-medical Waste Treatment Plant
4. Effluent Treatment Plant
5. Water purification plant
6. Orphanage / Elderly-Care-Home / School and or Hostel/Home for persons with disabilities
7. Primary health care centre

8. ER-2020 D.Pharm Syllabus – Part II

S. No.	Course Code	Name of the Course	Total Theory / Practical Hours	Total Tutorial Hours	Theory / Practical Hours per Week	Tutorial Hours per Week
1.	ER20-21T	Pharmacology – Theory	75	25	3	1
2.	ER20-21P	Pharmacology – Practical	50	-	2	-
3.	ER20-22T	Community Pharmacy & Management – Theory	75	25	3	1
4.	ER20-22P	Community Pharmacy & Management – Practical	75	-	3	-
5.	ER20-23T	Biochemistry & Clinical Pathology – Theory	75	25	3	1
6.	ER20-23P	Biochemistry & Clinical Pathology – Practical	50	-	2	-
7.	ER20-24T	Pharmacotherapeutics – Theory	75	25	3	1
8.	ER20-24P	Pharmacotherapeutics – Practical	25	-	1	-
9.	ER20-25T	Hospital & Clinical Pharmacy – Theory	75	25	3	1
10.	ER20-25P	Hospital & Clinical Pharmacy – Practical	25	-	1	-
11.	ER20-26T	Pharmacy Law & Ethics	75	25	3	1

PHARMACOLOGY – THEORY

Course Code: ER20-21T **75 Hours (3 Hours/week)**

Scope: This course provides basic knowledge about different classes of drugs available for the pharmacotherapy of common diseases. The indications for use, dosage regimen, routes of administration, pharmacokinetics, pharmacodynamics, and contraindications of the drugs discussed in this course are vital for successful professional practice.

Course Objectives: This course will discuss the following:

1. General concepts of pharmacology including pharmacokinetics, pharmacodynamics, routes of administration, etc.
2. Pharmacological classification and indications of drugs
3. Dosage regimen, mechanisms of action, contraindications of drugs
4. Common adverse effects of drugs

Course Outcomes: Upon successful completion of this course, the students will be able to

1. Describe the basic concepts of pharmacokinetics and pharmacodynamics2. Enlist the various classes and drugs of choices for any given disease condition
3. Advice the dosage regimen, route of administration and contraindications for a given drug
4. Describe the common adverse drug reactions

Chapter	Topic	Hours
1	**General Pharmacology** • Introduction and scope of Pharmacology • Various routes of drug administration - advantages and disadvantages • Drug absorption - definition, types, factors affecting drug absorption • Bioavailability and the factors affecting bioavailability • Drug distribution - definition, factors affecting drug distribution • Biotransformation of drugs - Definition, types of biotransformation reactions, factors influencing drug metabolisms • Excretion of drugs - Definition, routes of drug excretion • General mechanisms of drug action and factors modifying drug action	10

2	**Drugs Acting on the Peripheral Nervous System** • Steps involved in neurohumoral transmission • Definition, classification, pharmacological actions, dose, indications, and contraindications of a) Cholinergic drugs b) Anti-Cholinergic drugs c) Adrenergic drugs d) Anti-adrenergic drugs e) Neuromuscular blocking agents f) Drugs used in Myasthenia gravis g) Local anaesthetic agents h) Non-Steroidal Anti-Inflammatory drugs (NSAIDs)	**11**
3	**Drugs Acting on the Eye** Definition, classification, pharmacological actions, dose, indications and contraindications of • Miotics • Mydriatics • Drugs used in Glaucoma	**2**
4	**Drugs Acting on the Central Nervous System** Definition, classification, pharmacological actions, dose, indications, and contraindications of • General anaesthetics • Hypnotics and sedatives • Anti-Convulsant drugs • Anti-anxiety drugs • Anti-depressant drugs • Anti-psychotics • Nootropic agents • Centrally acting muscle relaxants • Opioid analgesics	**8**
5	**Drugs Acting on the Cardiovascular System** Definition, classification, pharmacological actions, dose, indications, and contraindications of • Anti-hypertensive drugs • Anti-anginal drugs • Anti-arrhythmic drugs • Drugs used in atherosclerosis and • Congestive heart failure • Drug therapy for shock	**6**

6	**Drugs Acting on Blood and Blood Forming Organs** Definition, classification, pharmacological actions, dose, indications, and contraindications of • Hematinic agents • Anti-coagulants • Anti-platelet agents • Thrombolytic drugs	**4**
7	Definition, classification, pharmacological actions, dose, indications, and contraindications of • Bronchodilators • Expectorants • Anti-tussive agents • Mucolytic agents	**2**
8	**Drugs Acting on the Gastro Intestinal Tract** Definition, classification, pharmacological actions, dose, indications, and contraindications of • Anti-ulcer drugs • Anti-emetics • Laxatives and purgatives • Anti-diarrheal drugs	**5**
9	**Drugs Acting on the Kidney** Definition, classification, pharmacological actions, dose, indications, and contraindications of • Diuretics • Anti-Diuretics	**2**
10	**Hormones and Hormone Antagonists** Physiological and pathological role and clinical uses of • Thyroid hormones • Anti-thyroid drugs • Parathormone • Calcitonin • Vitamin D • Insulin • Oral hypoglycemic agents • Estrogen • Progesterone • Oxytocin • Corticosteroids	**8**

11	**Autocoids** • Physiological role of Histamine, 5 HT and Prostaglandins • Classification, clinical uses, and adverse effects of antihistamines and 5 HT antagonists	**3**
12	**Chemotherapeutic Agents:** Introduction, basic principles of chemotherapy of infections, infestations and neoplastic diseases, Classification, dose, indication and contraindications of drugs belonging to following classes: • Penicillins • Cephalosporins • Aminoglycosides • Fluoroquinolones • Macrolides • Tetracyclines • Sulphonamides • Anti-tubercular drugs • Anti-fungal drugs • Anti-viral drugs • Anti-amoebic agents • Anthelmintics • Anti-malarial agents • Anti-neoplastic agents	**12**
13	**Biologicals** Definition, types, and indications of biological agents with examples	**2**

PHARMACOLOGY – PRACTICAL

Course Code: ER20-21P **50 Hours (2 Hours/week)**

Scope: This course provides the basic understanding about the uses, mechanisms of actions, dose dependent responses of drugs in simulated virtual animal models and experimental conditions.

Course Objectives: This course will demonstrate / provide hands-on experience in the virtual platform using appropriate software on the following

1. Study of pharmacological effects of drugs like local anaesthetics, mydriatic and mitotic on rabbit eye
2. Screening the effects of various drugs acting in the central nervous system
3. Study of drug effects on isolated organs / tissues
4. Study of pyrogen testing on rabbit

Course Outcomes: Upon successful completion of this course, the students will be able to

1. Study and report the local anaesthetic, mydriatic and mitotic effects of the given drug on the rabbit eye
2. Choose appropriate animal experiment model to study the effects of the given drugs acting on the central nervous system and submit the report
3. Perform the effects of given tissues (simulated) on isolated organs / tissues and interpret the results
4. Interpret the dose dependent responses of drugs in various animal experiment models

Practicals

Introduction to the following topics pertaining to the experimental pharmacology have to be discussed and documented in the practical manuals.

1. Introduction to experimental pharmacology
2. Study of laboratory animals
   (a) Mice; (b) Rats; (c) Guinea pigs; (d) Rabbits
3. Commonly used instruments in experimental pharmacology
4. Different routes of administration of drugs in animals
5. Types of pre-clinical experiments: In-Vivo, In-Vitro, Ex-Vivo, etc.
6. Techniques of blood collection from animals

Experiments

Note: Animals shall not be used for doing / demonstrating any of the experiments given. The given experiments shall be carried out / demonstrated as the case may be, ONLY with the use of software program(s) such as 'Ex Pharm' or any other suitable software

1. Study of local anaesthetics on rabbit eye
2. Study of Mydriatic effect on rabbit eye
3. Study of Miotic effect on rabbit eye
4. Effect of analgesics using Analgesiometer
5. Study of analgesic activity by writhing test
6. Screening of anti-convulsant using Electro Convulsiometer
7. Screening of Muscle relaxants using Rota-Rod apparatus
8. Screening of CNS stimulants and depressants using Actophotometer
9. Study of anxiolytic activity using elevated plus maze method
10. Study of effect of drugs (any 2) on isolated heart
11. Effect of drugs on ciliary motility on frog's buccal cavity
12. Pyrogen testing by rabbit method

Assignments

The students shall be asked to submit written assignments on the following topics (One assignment per student per sessional period. i.e., a minimum of THREE assignments per student)

1. Introduction to Allergy Testing
2. Introduction to Toxicity Studies
3. Drug Facts Labels of US FDA
4. Pre-clinical studies in new drug development
5. Medicines and meals: Before or After food
6. Pre-clinical studies in new drug development
7. Drugs available as paediatric formulations
8. Drug information apps

COMMUNITY PHARMACY AND MANAGEMENT – THEORY

Course Code: ER20-22T **75 Hours (3 Hours/week)**

Scope: The course is designed to impart basic knowledge and skills to provide various pharmaceutical care services to patients and general practitioners in the community setup.

Course Objectives: This course will discuss the following:

1. Establishing and running a community pharmacy and its legal requirements
2. Professional aspects of handling and filling prescriptions
3. Patient counselling on diseases, prescription and or non-prescription medicines
4. Scope for performing basic health screening in community pharmacy settings

Course Outcomes: Upon successful completion of this course, the students will be able to

1. Describe the establishment, legal requirements, and effective administration of a community pharmacy
2. Professionally handle prescriptions and dispense medications
3. Counsel patients about the disease, prescription and or non-prescription medicines
4. Perform basic health screening on patients and interpret the reports in the community pharmacy settings

Chapter	Topic	Hours
1	**Community Pharmacy Practice** – Definition, history and development of community pharmacy - International and Indian scenarios	2
2	Professional responsibilities of community pharmacists Introduction to the concept of Good Pharmacy Practice and SOPs.	3
3	**Prescription and prescription handling** • Definition, parts of prescriptions, legality of prescriptions, prescription handling, labelling of dispensed medications (Main label, ancillary label, pictograms), brief instructions on medication usage • Dispensing process, Good Dispensing Practices, dispensing errors and strategies to minimize them	7

4	**Communication skills** • Definition, types of communication skills • Interactions with professionals and patients • Verbal communication skills (one-to-one, over the telephone) • Written communication skills • Body language • Patient interview techniques	**6**
5	**Patient counselling** • Definition and benefits of patient counselling • **Stages of patient counselling** - Introduction, counselling content, counselling process, and closing the counselling session • **Barriers to effective counseling** - Types and strategies to overcome the barriers • **Patient counselling points for chronic diseases/disorders** - Hypertension, Diabetes, Asthma, Tuberculosis, Chronic obstructive pulmonary disease, and AIDS • **Patient Package Inserts** - Definition, importance and benefits, Scenarios of PPI use in India and other countries • **Patient Information leaflets** - Definition and uses	**10**
6	**Medication Adherence** Definition, factors influencing non-adherence, strategies to overcome non-adherence	**2**
7	**Health Screening Services in Community Pharmacy** Introduction, scope, and importance of various health screening services - for routine monitoring of patients, early detection, and referral of undiagnosed cases	**5**
9	**Over The Counter (OTC) Medications** • Definition, need and role of Pharmacists in OTC medication dispensing • OTC medications in India, counseling for OTC products • Self-medication and role of pharmacists in promoting the safe practices during self-medication • Responding to symptoms, minor ailments, and advice for self-care in conditions such as - Pain management, Cough, Cold, Diarrhea, Constipation, Vomiting, Fever, Sore throat, Skin disorders, Oral health (mouth ulcers, dental pain, gum swelling)	**15**

10	**Community Pharmacy Management** • Legal requirements to set up a community pharmacy • Site selection requirements • Pharmacy designs and interiors • Vendor selection and ordering • Procurement, inventory control methods, and inventory management • Financial planning and management • Accountancy in community pharmacy – Day book, Cash book • Introduction to pharmacy operation softwares – usefulness and availability • Customer Relation Management (CRM) • Audits in Pharmacies • SOP of Pharmacy Management • Introduction to Digital Health, mHealth and Online pharmacies	**25**

COMMUNITY PHARMACY AND MANAGEMENT – PRACTICAL

Course Code: ER20-22P **75 Hours (3 Hours/week)**

Scope: The course is designed to train the students and improve professional skills to provide various pharmaceuticalcare services in community pharmacy.

Course Objectives: This course will train the students in the following

1. Professional handling and filling prescriptions
2. Patient counselling on diseases and minor ailments
3. Patient counselling on prescription and / or non-prescription medicines
4. Preparation of counselling materials such as patient information leaflets
5. Performing basic health screening tests

Course Outcomes: Upon successful completion of this course, the students will be able to

1. Handle and fill prescriptions in a professional manner
2. Counsel patients on various diseases and minor ailments
3. Counsel patients on prescription and or non-prescription medicines
4. Design and prepare patient information leaflets
5. Perform basic health screening tests

Practicals

Note: The following practicals shall be carried out in the model community pharmacy with appropriate simulated scenarios and materials. Students shall be trained through role plays wherever necessary. The activities of the students shall be assessed / evaluated using a structured objective assessment form.

1. Handling of prescriptions with professional standards, reviewing prescriptions, checking for legal compliance and completeness (minimum 5)
2. Identification of drug-drug interactions in the prescription and follow-up actions (minimum 2)
3. Preparation of dispensing labels and auxiliary labels for the prescribed medications (minimum 5)
4. Providing the following health screening services for monitoring patients / detecting new patients (one experiment for each activity)

   Blood Pressure Recording, Capillary Blood Glucose Monitoring, Lung function assessment using Peak Flow Meter and incentive spirometer, recording capillary oxygen level using Pulse Oximeter, BMI measurement
5. Providing counselling to simulated patients for the following chronic diseases / disorders including education on the use of devices such as insulin pen, inhalers, spacers, nebulizers, etc. where appropriate (one experiment for each disease)

   Type 2 Diabetes Mellitus, Primary Hypertension, Asthma, Hyperlipidaemia, Rheumatoid Arthritis
6. Providing counselling to simulated patients for the following minor ailments (any three)

   Headache, GI disturbances (Nausea, Vomiting, Dyspepsia, diarrhoea, constipation), Worm infestations, Pyrexia, Upper Respiratory Tract infections, Skin infections, Oral and dental disorders.
7. Appropriate handling of dummy dosage forms with correct administration techniques - oral liquids with measuring cup/cap/dropper, Eye Drops, Inhalers, Nasal drops, Insulin pen, nebulizers, different types of tablets, patches, enemas, suppositories
8. Use of Community Pharmacy Software and digital health tools

Assignments

The students shall be asked to submit written assignments on the following topics (One assignment per student per sessional period. i.e., a minimum of THREE assignments per student)

1. SOPs for various activities in Community Pharmacy (as discussed in Theory and Practical)

2. List out the various abbreviations, short forms used in prescriptions and their interpretation
3. Patient Information Leaflet for a given chronic disease / disorder
4. Patient Information Leaflet for prescription / non-prescription medicines
5. Preparation of window / shelf display materials for the model community pharmacy
6. Overview of Software available for retail pharmacy management including billing, inventory, etc.
7. Dosage / Medication Reminder Aids
8. Overview on the operations and marketing strategies of various online pharmacies
9. Overview on the common fixed dose combinations
10. Overview on the medications requiring special storage conditions
11. Role of Community Pharmacists in preventing Antimicrobial Resistance
12. Jan Aushadhi and other Generic Medicine initiatives in India
13. Global Overview of Online Pharmacies
14. Community Pharmacy Practice Standards: Global Vs. Indian Scenario
15. Overview of pharmacy associations in India

Field Visit

The students shall be taken in groups to visit community pharmacies and medicine distributors to understand and witness the professional activities of the community pharmacists, and supply chain logistics. Individual reports from each student on their learning experience from the field visit shall be submitted.

BIOCHEMISTRY & CLINICAL PATHOLOGY – THEORY

Course Code: ER20-23T **75 Hours (3 Hours/week)**

Scope: This course is designed to impart basic knowledge on the study of structure and functions of biomolecules and the chemical processes associated with living cells in normal and abnormal states. The course also emphasizes on the clinical pathology of blood and urine.

Course Objectives: This course will discuss the following at the fundamental level

1. Structure and functions of biomolecules
2. Catalytic activity, diagnostic and therapeutic importance of enzymes
3. Metabolic pathways of biomolecules in health and illness (metabolic disorders)
4. Biochemical principles of organ function tests and their clinical significance
5. Qualitative and quantitative determination of biomolecules / metabolites in the biological sample
6. Clinical pathology of blood and urine

Course Outcomes: Upon successful completion of this course, the students will be able to

1. Describe the functions of biomolecules
2. Discuss the various functions of enzymes in the human system
3. Explain the metabolic pathways of biomolecules in both physiological and pathological conditions
4. Describe the principles of organ function tests and their clinical significances
5. Determine the biomolecules / metabolites in the given biological samples, both qualitatively and quantitatively
6. Describe the clinical pathology of blood and urine

Chapter	Topic	Hours
1	**Introduction to biochemistry**: Scope of biochemistry in pharmacy; Cell and its biochemical organization.	2
2	**Carbohydrates** • Definition, classification with examples, chemical properties • Monosaccharides - Structure of glucose, fructose, and galactose • Disaccharides - structure of maltose, lactose, and sucrose • Polysaccharides - chemical nature of starch and glycogen • Qualitative tests and biological role of carbohydrates	5

3	**Proteins** • Definition, classification of proteins based on composition and solubility with examples • Definition, classification of amino acids based on chemical nature and nutritional requirements with examples • Structure of proteins (four levels of organization of protein structure) • Qualitative tests and biological role of proteins and amino acids • Diseases related to malnutrition of proteins.	**5**
4	**Lipids** • Definition, classification with examples • Structure and properties of triglycerides (oils and fats) • Fatty acid classification - Based on chemical and nutritional requirements with examples • Structure and functions of cholesterol in the body • Lipoproteins - types, composition and functions in the body • Qualitative tests and functions of lipids	**5**
5	**Nucleic acids** • Definition, purine and pyrimidine bases • Components of nucleosides and nucleotides with examples • Structure of DNA (Watson and Crick model), RNA and their functions	**4**
6	**Enzymes** • Definition, properties and IUB and MB classification • Factors affecting enzyme activity • Mechanism of action of enzymes, Enzyme inhibitors • Therapeutic and pharmaceutical importance of enzymes	**5**
7	**Vitamins** • Definition and classification with examples • Sources, chemical nature, functions, coenzyme form, recommended dietary requirements, deficiency diseases of fat-and water-soluble vitamins	**6**
8	**Metabolism** (Study of cycle/pathways without chemical structures) • Metabolism of Carbohydrates: Glycolysis, TCA cycle and glycogen metabolism, regulation of blood glucose	**20**

	level. Diseases related to abnormal metabolism of Carbohydrates • Metabolism of lipids: Lipolysis, β-oxidation of Fatty acid (Palmitic acid) ketogenesis and ketolysis. Diseases related to abnormal metabolism of lipids such as Ketoacidosis, Fatty liver, Hypercholesterolemia • Metabolism of Amino acids (Proteins): General reactions of amino acids and its significance– Transamination, deamination, Urea cycle and decarboxylation. Diseases related to abnormal metabolism of amino acids, Disorders of ammonia metabolism, phenylketonuria, alkaptonuria and Jaundice. • Biological oxidation: Electron transport chain and Oxidative phosphorylation	
9	**Minerals**: Types, Functions, Deficiency diseases, recommended dietary requirements	**05**
10	**Water and Electrolytes** • Distribution, functions of water in the body • Water turnover and balance • Electrolyte composition of the body fluids, Dietary intake of electrolyte and Electrolyte balance • Dehydration, causes of dehydration and oral rehydration therapy	**05**
11	Introduction to Biotechnology	**01**
12	**Organ function tests** • Functions of kidney and routinely performed tests to assess the functions of kidney and their clinical significances • Functions of liver and routinely performed tests to assess the functions of liver and their clinical significances • Lipid profile tests and its clinical significances	**06**
13	**Introduction to Pathology of Blood and Urine** • Lymphocytes and Platelets, their role in health and disease • Erythrocytes - Abnormal cells and their significance • Normal and Abnormal constituents of Urine and their significance	**06**

BIOCHEMISTRY & CLINICAL PATHOLOGY – PRACTICAL

Course Code: ER20-23P **50 Hours (2 Hours/week)**

Scope: This course is designed to train the students in the qualitative testing of various biomolecules and testing of biological samples for determination of normal and abnormal constituents

Course Objectives: This course will train and provide hands-on experiences on the following

1. Qualitative determination of biomolecules / metabolites in simulated biological samples
2. Determination of normal and abnormal constituents of simulated blood and urine samples

Course Outcomes: Upon successful completion of this course, the students will be able to

1. Qualitatively determine the biomolecules / metabolites in the given biological samples
2. Determine the normal and abnormal constituents in blood and urine samples and interpret the results of such testing

Practicals

1. Qualitative analysis of carbohydrates (4 experiments)
2. Qualitative analysis of Proteins and amino acids (4 experiments)
3. Qualitative analysis of lipids (2 experiments)
4. Qualitative analysis of urine for normal and abnormal constituents (4 experiments)
5. Determination of constituents of urine (glucose, creatinine, chlorides) (2 experiments)
6. Determination of constituents of blood/serum (simulated) (Creatine, glucose, cholesterol, Calcium, Urea, SGOT/SGPT) (5 experiments)
7. Study the hydrolysis of starch from acid and salivary amylase enzyme (1 experiment)

Assignments

The students shall be asked to submit written assignments on Various Pathology Lab Reports (One assignment per student per sessional period. i.e., a minimum of THREE assignments per student)

PHARMACOTHERAPEUTICS - THEORY

Course Code: ER20-24T **75 Hours (3 Hours/week)**

Scope: This course is designed to impart basic knowledge on etiopathogenesis of common diseases and their management along with quality use of medicines.

Course Objectives: This course will discuss about

1. Etiopathogenesis of selected common diseases and evidence-based medicine therapy
2. Importance of individualized therapeutic plans based on diagnosis
3. Basic methods for assessing the clinical outcomes of drug therapy

Course Outcomes: Upon successful completion of this course, the students will be able to

1. Help assessing the subjective and objective parameters of patients in common disease conditions
2. Assist other healthcare providers to analyse drug related problems and provide therapeutic interventions
3. Participate in planning the rational medicine therapy for common diseases
4. Design and deliver discharge counselling for patients

Chapter	Topic	Hours
1	Pharmacotherapeutics – Introduction, scope, and objectives. Rational use of Medicines, Evidence Based Medicine, Essential Medicines List, Standard Treatment Guidelines (STGs)	**8**
2	**Definition, etiopathogenesis, clinical manifestations, non-pharmacological and pharmacological management of the diseases associated with**	
	(a) Cardiovascular System • Hypertension • Angina and Myocardial infarction • Hyperlipidaemia • Congestive Heart Failure	**8**
	(b) Respiratory System • Asthma • COPD	**4**
	(c) Endocrine System • Diabetes • Thyroid disorders - Hypo and Hyperthyroidism	**5**
	(d) Central Nervous System • Epilepsy	**8**

	• Parkinson's disease • Alzheimer's disease • Stroke • Migraine	
	(e) Gastro Intestinal Disorders • Gastro oesophageal reflux disease • Peptic Ulcer Disease • Alcoholic liver disease • Inflammatory Bowel Diseases (Crohn's Disease and Ulcerative Colitis)	**8**
	(f) Haematological disorders • Iron deficiency anaemia • Megaloblastic anaemia	**4**
	(g) Infectious diseases • Tuberculosis • Pneumonia • Urinary tract infections • Hepatitis • Gonorrhoea and Syphilis • Malaria • HIV and Opportunistic infections • Viral Infections (SARS, CoV2)	**12**
	(h) Musculoskeletal disorders • Rheumatoid arthritis • Osteoarthritis	**3**
	(i) Dermatology • Psoriasis • Scabies • Eczema	**3**
	(j) Psychiatric Disorders • Depression • Anxiety • Psychosis	**4**
	(k) Ophthalmology • Conjunctivitis (bacterial and viral) • Glaucoma	**2**
	(l) Anti-microbial Resistance	**2**
	(m) Women's Health • Polycystic Ovary Syndrome • Dysmenorrhea • Premenstrual Syndrome	**4**

PHARMACOTHERAPEUTICS – PRACTICAL

Course Code: ER20-24P **25 Hours (1 Hour/week)**

Scope: This course is designed to train the students in the basic skills required to support the pharmaceutical care services for selected common disease conditions.

Course Objectives: This course will train the students on

1. How to prepare a SOAP (Subjective, Objective, Assessment and Plan) note for clinical cases of selected common diseases
2. Patient counselling techniques/methods for common disease conditions

Course Outcomes: Upon successful completion of this course, the students will be able to

1. Write SOAP (Subjective, Objective, Assessment and Plan) notes for the given clinical cases of selected common diseases
2. Counsel the patients about the disease conditions, uses of drugs, methods of handling and administration of drugs, life-style modifications, and monitoring parameters.

Practicals

I. Preparation and discussion of SOAP (Subjective, Objective, Assessment and Plan) notes for at least SIX clinical cases (real / hypothetical) of the following disease conditions.

1. Hypertension
2. Angina Pectoris
3. Myocardial Infarction
4. Hyperlipidaemia
5. Rheumatoid arthritis
6. Asthma
7. COPD
8. Diabetes
9. Epilepsy
10. Stroke
11. Depression
12. Tuberculosis
13. Anaemia (any one type as covered in theory)
14. Viral infection (any one type as covered in theory)
15. Dermatological conditions (any one condition as covered in theory)

II. Patient counselling exercises using role plays based on the real / hypothetical clinical case scenarios. The students are expected to provide counselling on disease condition, medications, life-style modifications, monitoring parameters, etc. and the same shall be documented. (Minimum 5 cases)

III. Simulated cases to enable dose calculation of selected drugs in paediatrics, and geriatrics under various pathological conditions. (Minimum 4 cases)

HOSPITAL AND CLINICAL PHARMACY – THEORY

Course Code: ER20-25T **75 Hours (3 Hours/week)**

Scope: This course is designed to impart fundamental knowledge and professional skills required for facilitating various hospital and clinical pharmacy services.

Course Objectives: This course will discuss and train the students in the following

1. Hospital and Hospital Pharmacy organization and set-ups
2. Basics of hospital pharmacy services including the procurement, supply chain, storage of medicines and medical supplies
3. Basics of clinical pharmacy including introduction to comprehensive pharmaceutical care services
4. Basic interpretations of common laboratory results used in clinical diagnosis towards optimizing the drug therapy

Course Outcomes: Upon successful completion of this course, the students will be able to

1. Explain about the basic concepts of hospital pharmacy administration
2. Manage the supply chain and distribution of medicines within the hospital settings
3. Assist the other healthcare providers in monitoring drug therapy and address drug related problems
4. Interpret common lab investigation reports for optimizing drug therapy

S. No.	Topic	Hours
1	**Hospital Pharmacy** • Definition, scope, national and international scenario • Organisational structure • Professional responsibilities, Qualification and experience requirements, job specifications, work–load requirements and inter professional relationships • Good Pharmacy Practice (GPP) in hospital • Hospital Pharmacy Standards (FIP Basel Statements, AHSP) • Introduction to NAQS guidelines and NABH Accreditation and Role of Pharmacists	6
2	**Different Committees in the Hospital** • Pharmacy and Therapeutics Committee - Objectives, Composition, and functions • Hospital Formulary - Definition, procedure for development and use of hospital formulary	4

	• Infection Control Committee – Role of Pharmacist in preventing Antimicrobial Resistance	
4	**Supply Chain and Inventory Control** • Preparation of Drug lists - High Risk drugs, Emergency drugs, Schedule H1 drugs, NDPS drugs, reserved antibiotics • Procedures of Drug Purchases – Drug selection, short term, long term, and tender/e-tender process, quotations, etc. • Inventory control techniques: Economic Order Quantity, Reorder Quantity Level, Inventory Turnover etc. • Inventory Management of Central Drug Store – Storage conditions, Methods of storage, Distribution, Maintaining Cold Chain, Devices used for cold storage (Refrigerator, ILR, Walk-in-Cold rooms) • FEFO, FIFO methods • Expiry drug removal and handling, and disposal. Disposal of Narcotics, cytotoxic drugs • Documentation - purchase and inventory	**14**
5	**Drug distribution** • Drug distribution (in- patients and out - patients) – Definition, advantages and disadvantages of individual prescription order method, Floor Stock Method, Unit Dose Drug Distribution Method, Drug Basket Method. • Distribution of drugs to ICCU/ICU/NICU/Emergency wards. • Automated drug dispensing systems and devices • Distribution of Narcotic and Psychotropic substances and their storage	**7**
6	Compounding in Hospitals. Bulk compounding, IV admixture services and incompatibilities, Total parenteral nutrition	**4**
7	**Radio Pharmaceuticals -** Storage, dispensing and disposal of radiopharmaceuticals	**2**
8	Application of computers in Hospital Pharmacy Practice, Electronic health records, Softwares used in hospital pharmacy	**2**
9	**Clinical Pharmacy:** Definition, scope, and development - in India and other countries Technical definitions, common terminologies used in clinical settings and their significance such as Paediatrics, Geriatric, Anti-natal Care, Post-natal Care, etc.	**12**

	Daily activities of clinical pharmacists: Definition, goal, and procedure of • Ward round participation • Treatment Chart Review • Adverse drug reaction monitoring • Drug information and poisons information • Medication history • Patient counselling • Interprofessional collaboration **Pharmaceutical care**: Definition, classification of drug related problems. Principles and procedure to provide pharmaceutical care **Medication Therapy Management, Home Medication Review**	
10	**Clinical laboratory tests used in the evaluation of disease states - significance and interpretation of test results** • Haematological, Liver function, Renal function, thyroid function tests • Tests associated with cardiac disorders • Fluid and electrolyte balance • Pulmonary Function Tests	**10**
11	**Poisoning**: Types of poisoning: Clinical manifestations and Antidotes **Drugs and Poison Information Centre and their services** – Definition, Requirements, Information resources with examples, and their advantages and disadvantages	**6**
12	**Pharmacovigilance** • Definition, aim and scope • Overview of Pharmacovigilance	**2**
13	**Medication errors**: Definition, types, consequences, and strategies to minimize medication errors, LASA drugs and Tallman lettering as per ISMP **Drug Interactions:** Definition, types, clinical significance of drug interactions	**6**

HOSPITAL AND CLINICAL PHARMACY – PRACTICAL

Course Code: ER20-25P **25 Hours (1 Hour / Week)**

Scope: This course is designed to train the students to assist other healthcare providers in the basic services of hospital and clinical pharmacy.

Course Objectives: This course will train the students with hands-on experiences, simulated clinical case studies in the following:

1. Methods to systematically approach and respond to drug information queries
2. How to interpret common laboratory reports to understand the need for optimizing dosage regimens
3. How to report suspected adverse drug reactions to the concerned authorities
4. Uses and methods of handling various medical/surgical aids and devices
5. How to interpret drug-drug interactions in the treatment of common diseases.

Course Outcomes: Upon completion of the course, the students will be able to

1. Professionally handle and answer the drug information queries
2. Interpret the common laboratory reports
3. Report suspected adverse drug reactions using standard procedures
4. Understand the uses and methods of handling various medical/surgical aids and devices
5. Interpret and report the drug-drug interactions in common diseases for optimizing the drug therapy

Note: Few of the experiments of Hospital and Clinical Pharmacy practical course listed here require adequate numbers of desktop computers with internet connectivity, adequate drug information resources including reference books, different types of surgical dressings and other medical devices and accessories. Various charts, models, exhibits pertaining to the experiments shall also be displayed in the laboratory.

Practicals

1. Systematic approach to drug information queries using primary / secondary / tertiary resources of information (2 cases)
2. Interpretation of laboratory reports to optimize the drug therapy in a given clinical case (2 cases)
3. Filling up IPC's ADR Reporting Form and perform causality assessments using various scales (2 cases)
4. Demonstration / simulated / hands-on experience on the identification, types, use / application /administration of
    - Orthopaedic and Surgical Aids such as knee cap, LS belts, abdominal belt, walker, walking sticks, etc.

- Different types of bandages such as sterile gauze, cotton, crepe bandages, etc.
- Needles, syringes, catheters, IV set, urine bag, RYLE's tube, urine pots, colostomy bags, oxygen masks, etc.

5. Case studies on drug-drug interactions (any 2 cases)
6. Wound dressing (simulated cases and role play –minimum 2 cases)
7. Vaccination and injection techniques (IV, IM, SC) using mannequins (5 activities)
8. Use of Hospital Pharmacy Software and various digital health tools

Assignments

The students shall be asked to submit written assignments on the following topics (One assignment per student per sessional period. i.e., a minimum of THREE assignments per student)

1. Typical profile of a drug to be included in the hospital formulary
2. Brief layout and various services of the Central Sterile Supplies Department (CSSD)
3. Various types of sterilizers and sterilization techniques used in hospitals
4. Fumigation and pesticide control in hospitals
5. Role of Pharmacists in Transition of Care: Discharge cards, post hospitalization care, medicine reconciliation activities in developed countries
6. Total parenteral nutrition and IV admixtures and their compatibility issues
7. Concept of electronic health records
8. Invasive and Non-invasive diagnostic tests - HRCT, MRI, Sonography, 2D ECHO, X-rays, Mammography, ECG, EMG, EEG
9. Home Diagnostic Kits - Pregnancy Test, COVID testing etc
10. Measures to be taken in hospitals to minimize Antimicrobial Resistance
11. Role and responsibilities of a pharmacist in public hospital in rural parts of the country
12. Safe waste disposal of hospital waste

Field Visit

The students shall be taken in groups to visit a Government / private healthcare facility to understand and witness the various hospital and clinical pharmacy services provided. Individual reports from each student on their learning experience from the field visit shall be submitted.

PHARMACY LAW AND ETHICS – THEORY

Course Code: ER20-26T **75 Hours (3 Hours/week)**

Scope: This course is designed to impart basic knowledge on several important legislations related to the profession of pharmacy in India

Course Objectives: This course will discuss the following

1. General perspectives, history, evolution of pharmacy law in India
2. Act and Rules regulating the profession and practice of pharmacy in India
3. Important code of ethical guidelines pertaining to various practice standards
4. Brief introduction to the patent laws and their applications in pharmacy

Course Outcomes: Upon successful completion of this course, the students will be able to

1. Describe the history and evolution of pharmacy law in India
2. Interpret the act and rules regulating the profession and practice of pharmacy in India
3. Discuss the various codes of ethics related to practice standards in pharmacy
4. Interpret the fundamentals of patent laws from the perspectives of pharmacy

Chapter	Topics	Hours
1	General Principles of Law, History and various Acts related to Drugs and Pharmacy profession	2
2	**Pharmacy Act-1948 and Rules:** Objectives, Definitions, Pharmacy Council of India; its constitution and functions, Education Regulations, State and Joint state pharmacy councils, Registration of Pharmacists, Offences and Penalties. **Pharmacy Practice Regulations 2015**	5
3	**Drugs and Cosmetics Act 1940 and Rules 1945 and New Amendments** Objectives, Definitions, Legal definitions of schedules to the Act and Rules **Import of drugs** – Classes of drugs and cosmetics prohibited from import, Import under license or permit.	23

	Manufacture of drugs – Prohibition of manufacture and sale of certain drugs, Conditions for grant of license and conditions of license for manufacture of drugs, Manufacture of drugs for test, examination and analysis, manufacture of new drug, loan license and repacking license. Study of schedule C and C1, G, H, H1, K, P, M, N, and X. ***Sale of Drugs*** – Wholesale, Retail sale and Restricted license, Records to be kept in a pharmacy Drugs Prohibited for manufacture and sale in India ***Administration of the Act and Rules*** – Drugs Technical Advisory Board, Central Drugs Laboratory, Drugs Consultative Committee, Government analysts, licensing authorities, controlling authorities, Drug Inspectors.	
4	**Narcotic Drugs and Psychotropic Substances Act 1985 and Rules** Objectives, Definitions, Authorities and Officers, Prohibition, Control and Regulation, Offences and Penalties.	**2**
5	**Drugs and Magic Remedies (Objectionable Advertisements) Act 1954** Objectives, Definitions, Prohibition of certain advertisements, Classes of Exempted advertisements, Offences and Penalties.	**2**
6	**Prevention of Cruelty to Animals Act-1960**: Objectives, Definitions, CPCSEA - brief overview, Institutional Animal Ethics Committee, Breeding and Stocking of Animals, Performance of Experiments, Transfer and Acquisition of animals for experiment, Records, Power to suspend or revoke registration, Offences and Penalties.	**2**
7	**Poisons Act-1919**: Introduction, objective, definition, possession, possession for sales and sale of any poison, import of poisons	**2**
8	**FSSAI (Food Safety and Standards Authority of India) Act and Rules**: brief overview and aspects related to manufacture, storage, sale, and labelling of Food Supplements	**2**

9	**National Pharmaceutical Pricing Authority**: Drugs Price Control Order (DPCO) - 2013. Objectives, Definitions, Sale prices of bulk drugs, Retail price of formulations, Retail price and ceiling price of scheduled formulations, Pharmaceutical Policy 2002, National List of Essential Medicines (NLEM)	**5**
10	**Code of Pharmaceutical Ethics**: Definition, ethical principles, ethical problem solving, registration, code of ethics for Pharmacist in relation to his job, trade, medical profession and his profession, Pharmacist's oath.	**5**
11	Medical Termination of Pregnancy Act and Rules – basic understanding, salient features, and Amendments	**2**
12	Role of all the government pharma regulator bodies – Central Drugs Standards Control Organization (CDSCO), Indian Pharmacopoeia Commission (IPC)	**1**
13	Good Regulatory practices (documentation, licenses, renewals, e-governance) in Community Pharmacy, Hospital pharmacy, Pharma Manufacturing, Wholesale business**,** inspections, import, export of drugs and medical devices	**3**
14	Introduction to BCS system of classification, Basic concepts of Clinical Trials, ANDA, NDA, New Drug development, New Drugs and Clinical Trials Rules, 2019. Brand v/s Generic, Trade name concept, Introduction to Patent Law and Intellectual Property Rights, Emergency Use Authorization	**7**
15	Blood bank – basic requirements and functions	**2**
16	Clinical Establishment Act and Rules – Aspects related to Pharmacy	**2**
17	Biomedical Waste Management Rules 2016 – Basic aspects, and aspects related to pharma manufacture to disposal of pharma / medical waste at homes, pharmacies, and hospitals	**2**
18	Bioethics - Basic concepts, history and principles. Brief overview of ICMR's National Ethical Guidelines for Biomedical and Health Research involving human participants	**2**
19	Introduction to the Consumer Protection Act	**1**
20	Introduction to the Disaster Management Act	**1**
21	Medical Devices – Categorization, basic aspects related to manufacture and sale	**2**

Assignments

The students shall be asked to submit written assignments on the following topics (One assignment per student per sessional period. i.e., a minimum of THREE assignments per student)

1. Requirements for Ayurvedic, Homeopathic manufacturing, sale, and licensing requirements
2. Layout and contents of official websites of various agencies regulating the profession of pharmacy in India: e.g., CDSCO, SUGAM portal, PCI, etc.
3. Licenses required, application processes (online/offline), drug regulatory office website of the respective state
4. Case studies – actions taken on violation of any act / rule related to pharmacy
5. Schedule H1 drugs and its implementation in India
6. Counterfeit / Spurious medicines
7. Drug Testing Labs in India
8. Overview of Pharma marketing practices
9. Generic Medicines

9. Appendices

No	Appendix Document
1.	A typical format for the assessment of an Assignment
2.	A typical format for the assessment of a Field Visit Report
3.	List of instruments and equipment required for the conduct of D.Pharm program as per ER-2020

Appendix – 1

A typical format for the assessment of an Assignment

Name of the College:

Name of the Student:	
Academic Year of the Student:	
Name of the Subject:	
Title of the Assignment:	
Date on which the Assignment was given:	
Date on which the Assignment was submitted:	
Name & Designation of the Evaluator:	
Signature of the Evaluator with Date:	

Directions: For **evaluation,** enter rating of the student utilizing the following scale:

5 – Excellent; 4 - Very Good; 3 – Good; 2 – Satisfactory; 1 - Poor

Assessment Criteria	Score	Comments if any
a. Relevance with the content		
b. Use of resource material		
c. Organization & mechanical accuracy		
d. Cohesion & coherence		
e. Language proficiency & Timely submission		
Total Score		

Signature of the Student with Date:

Note: Subject teacher should try to cover all assignments mentioned in the list for each practical subject by assigning the topics to the students. Students should be encouraged to submit an assignment (in a format decided by the Institute) and encouraged to present assignments (at least any one assignment per subject) in the class**.**

Appendix – 2

A typical format for the assessment of a Field Visit Report

Name of the College:

Name of the Student:	
Academic Year of the Student:	
Name of the Subject:	
Name & full address of the organization visited:	
Date and Duration of Visit:	
Name & Designation of the Evaluator:	
Signature of the Evaluator with Date:	

Objectives set for the field visit: (give 2 – 4 objectives one by one)
Prior preparation of the student for the field visit: (minimum 100 words)
Describe the general experiences during the field visit: (minimum 100 words)
Learning points: Describe what theoretical concept that is correlated during the field visit: (minimum 300 words)

Appendix – 3

List of Instruments and Equipment required for the Conduct of D.Pharm program as per ER-2020

As per ER 2020 regulation;

At least four laboratories specified below should be provided for:

1. Pharmaceutics Lab.
2. Pharm. Chemistry Lab.
3. Physiology, Pharmacology and Pharmacognosy Lab.
4. Biochemistry, Clinical Pathology, Hospital and Clinical Pharmacy Lab.

The institutions shall provide “Model Pharmacy” as per following details

Model Pharmacy	No.	Area
Essential: Running Model Community Pharmacy **Desirable**: Drug Model Store	01	80 Sq. Mts. (Including 10 Sq. mt. for Drug Information Centre & 10 Sq. mt. for Patient Counselling)

NOTE: Wherever animal experimentations are prescribed in the curriculum, the required knowledge and skill should be imparted by using computer assisted modules. Animal hold area shall be as per the Committee for the Purpose of Control and Supervision of Experiments on Animals (CPCSEA) guidelines.

Practical of Social Pharmacy, Pharmacotherapeutics can be conducted in any one of the laboratories by making necessary provisions.

Department wise List of Minimum Equipment required for D.Pharm (For a practical batch of 20 students)

1. Physiology, Pharmacology and Pharmacognosy Lab.

S. No.	Name	Minimum required Nos. for DPharm 60 intake
1	Microscopes	20
2	Haemocytometer with Micropipettes	20
3	Sahli's haemoglobinometers	20
4	Sphygmomanometers	5
5	Stethoscopes	10
6	Human Permanent Slides for various tissues	One pair of each tissue Organs and endocrine glands
7	Models for various organs	One model of each organ system
8	Specimen for various organs and systems	One model for each organ system
9	Human Skeleton and bones	One set of skeleton and one spare bone
10	Different Contraceptive Devices and Models	One set of each device
11	Digital Balance (10 mg Sensitivity)	1
12	Computer with LCD	1
13	Licensed Software packages for Physiological & Pharmacological experiment	1
14	IR Thermometer	2
15	Refrigerator	1
16	First aid equipment	Adequate number
17	Stop watch	20
18	Dummy Inhalers and Nebulizer	1
19	Pharmacotherapeutic charts for various diseases & disorders	Adequate number
20	Surgical devices and Sutures	Adequate number
21	Digital BP Instrument	5
22	Mercury Thermometer	10
23	Digital Thermometer	10
24	Pulse Oximeter	5
25	ESR Apparatus (Westergren and Wintrobe)	10
26	Peak Flow meter	10
27	Stadiometer	2
28	Adult Weighing Scale (150 kg)	5
29	Glucometer	10
30	Projection microscope	1
31	Permanent slide set of plants and charts for Pharmacognosy Lab	Adequate number
32	Drug information resources	Adequate number
33	Various types of PPE Kits,	Adequate number

34	Charts /displays/ AVs on tobacco control, glycemic index of foods, nutrition, reproductive health	Adequate number
35	Menstrual hygiene products	Adequate number
36	Display for various disinfectants, mosquito repellents etc	Adequate number
37	Water Testing Kit	Adequate number
38	Permanent slide of different microbes	Adequate number

NOTE: Adequate number of glassware commonly used in the laboratory should be provided in each laboratory and department

2. Pharmaceutical Chemistry/ Biochemistry, Clinical Pathology

S. No.	Name	Minimum required Nos. for DPharm 60 intake
1	Hot plates	5
2	Hot Air Oven	1
3	Refrigerator	1
4	Analytical Balances for demonstration	1
5	Digital balance 10mg sensitivity	5
6	Magnetic Stirrers with Thermostat	10
7	Vacuum Pump	1
8	Digital pH meter	1
9	Wall Mounted Water Distillation Unit	2
10	Nessler's Cylinders	40
11	Digital Melting Point Apparatus	2
12	Thieles Tube	20
13	Digital Colorimeter	2
14	Thermostatic Water Bath	1

NOTE: Adequate number of glassware commonly used in the laboratory should be provided in each laboratory and department

3. Pharmaceutics

S. No.	Name	Minimum required Nos. for DPharm 60 intake
1	Digital balance (10mg)	5
2	Microscopes	10
3	Autoclave	1
4	Vacuum Pump	1
5	Standard sieves, sieve no. 8, 10, 12,22,24, 44, 54, 60, 80, 85, 100, 120	10 sets
6	Tablet dissolution test apparatus IP (Digital single/double Unit)	1
7	Magnetic stirrer, 500ml and 1 litter capacity with speed control	5

8	Digital pH meter	1
9	Capsule Counter	2
10	Hot Plate	2
11	Distillation Unit	1
12	Tablet counter – small size	2
13	Hot air oven	1
14	Electric water bath unit	2
15	Stalagmometer	5
16	Desiccator	5
17	Buchner Funnels (Medium)	10
18	Filtration assembly with Vacuum Pump	1
19	Andreasen's Pipette	5
20	Ointment slab	20
21	Ointment spatula	20
22	Pestle and mortar porcelain	20
23	Refrigerator	1
24	Micrometre slide Eyepiece	5
25	Micrometre slide Stage	5
26	Viscometer Ostwald/Brookfield	1
27	Stop watch	1
28	Sintered glass filter with vacuum	4

NOTE: Aseptic cabinet or area should be provided as per Appendix A of ER 2020 Adequate number of glassware commonly used in the laboratory should be provided in each laboratory and department

Machine Room

S. No.	Name	Minimum required Nos. for D.Pharm 60 intake
1	Capsule filling machine	1
2	Automated Single Station Tablet punching machine	1
3	Tablet disintegration test apparatus IP (Digital Single/Double unit)	1
4	Monsanto's hardness tester	2
5	Pfizer type hardness tester	2
6	Friability test apparatus (Digital Single/Double unit)	1
7	Sieve shaker with sieve set	1
8	Ointment filling machine	1
9	All-purpose equipment with all accessories	1
10	Bottle washing Machine	1
11	Bottle Sealing Machine	1
12	Liquid Filling Machine	1
13	Ampoule washing machine	1
14	Ampoule filling and sealing machine (Jet Burner)	1

15	Clarity test apparatus	1
16	Collapsible tube – Filling and Sealing	1
17	Liquid Mixer	1

NOTE: Adequate number of glassware commonly used in the laboratory should be provided in each laboratory and department

4. Hospital and Clinical Pharmacy Lab

S. No.	Name	Minimum required Nos for D.Pharm 60 intake
1	Orthopaedical & Surgical Aids such as knee cap, LS belts, abdominal belt, walker, walking sticks, etc	Adequate Number
2	Different Types of bandages such as sterile gauze, cotton, crepe bandages, roll bandage etc	Adequate Number
3	Mannequins for CPR-1 (with indication Signals)	2
4	Mannequins for injection IV Arm	2
5	Variety of Needles	20
6	Variety of Syringes	20
7	Variety of catheters	5
8	IV set	20
9	Urine Bag	2
10	RYLE's tube	2
11	Urine pots	2
12	Colostomy bags	2
13	Oxygen masks	10
14	Inventory Software for Retail Pharmacy	1

NOTE: Adequate number of glassware commonly used in the laboratory should be provided in each laboratory and department

5. Model Pharmacy

S. No.	Name	Minimum required Nos. for D.Pharm 60 intake (
1	• Empty cartons of variety medicines (across variety dosage forms) • Various name plates indicating different parts of Pharmacy, • Proper arrangement of medicines, shelves, racks, drawers • Box/area for expiry medicines, • Display windows, shelves • Computer • Refrigerator • Designated patient counselling area, • Patient Information -Leaflets/Cards • Patient waiting area, • Drug Information books • Health information display, • Various devices for screening services (B.P. monitor, glucometer etc) • Height and body weight chart • Dummy devices (eg. Inhalers) • Display of pharmacist registration, license and other licenses • Display of name of owner • Inspection book, • Lock and key arrangement for Schedule X and NDPS medicines, • Bill book (dummy) , Computer stationary for bill printing	Adequate
2	Computers: hospital and community pharmacy management software	1

APPENDIX 4

Subject wise list of Recommended Books (Latest Edition)

Pharmaceutics

1. History of Pharmacy in India by Dr. Harikishan Singh
2. Indian Pharmacopoeia, Govt. of India Publication
3. A Text book of Pharmaceuticals Formulation by B.M. Mithal, Vallabh Prakashan.
4. Bentleys' Text book of Pharmaceutics, Editor E.A. Rawlins, Elsevier Int.,
5. The Theory and Practice of Industrial Pharmacy. Leon Lachman, Herbert Lieberman and Joseph Kanig, Editors, Lea and Febiger, Philadelphia. Varghese Publishing House
6. Responsible Use of Medicines: A Layman's Handbook, www.ipapharma.org / publications

Pharmaceutical Chemistry

1. Medicinal & Pharmaceutical chemistry by Harikishan Singh and VK Kapoor
2. Wilson and Griswold's Text book of Organic Medicinal and pharmaceutical Chemistry
3. Practical Organic Chemistry by Mann and Saunders.
4. Practical Pharmaceutical Chemistry, Volume- I & II by Beckett and J. B. Stenlake
5. Indian Pharmacopoeia
6. Vogel's text book of Practical Organic Chemistry

Pharmacognosy

1. Text book of Pharmacognosy by C. K. Kokate, S. B. Gokhale, A.P. Purohit, Nirali Prakashan
2. Text book of Pharmacognosy by C.S. Shah and J. S. Qadry, CBS Publishers & Distributors Pvt. Ltd.
3. Text Book of Pharmacognosy by T. E. Wallis. CBS Publishers & Distributors Pvt. Ltd.
4. Study of crude drugs by M. A. Iyengar, Manipal Press Ltd, Manipal
5. Powder crude drugs by M. A. Iyengar, Manipal Press Ltd, Manipal
6. Anatomy of crude drugs by M. A. Iyengar, Manipal Press Ltd, Manipal
7. Augmented Text Book of Homeopathic Pharmacy by Dr. D D Banerjee, B Jain Publishers (P) Ltd

Human Anatomy and Physiology

1. Human Physiology by C. C. Chatterjee
2. Human Anatomy and Physiology by S. Chaudhary and A. Chaudhary
3. Derasari and Gandhi's elements of Human Anatomy, Physiology and Health Education
4. S.R. Kale and R.R. Kale, Textbook of Practical Anatomy and Physiology
5. Ross and Wilson Anatomy and Physiology in Health and illness
6. Human Anatomy and Physiology by Tortora Gerard J
7. Fundamentals of Medical Physiology by K. Sambulingam and P Sambulingam
8. Ranade V.G. Text Book of Practical Physiology
9. Goyal R.K., Natvar M.P. and Shah S.A., Practical Anatomy, Physiology and Biochemistry, Experimental Physiology

Social Pharmacy

1. Social Pharmacy – Innovation and development. Geoff Harding, Sarah Nettleton and Kevin Taylor. The Pharmaceutical Press.
2. Text Book of Community Pharmacy Practice. RPSGB Publication
3. Community Pharmacy Handbook- Jonathan Waterfield
4. S Khurana, P Suresh and R Kalsi. Health Education & Community Pharmacy. S Vikas & Co
5. Social Pharmacy: Tayler, Geoffrey. Pharmaceutical Press. London.
6. Textbook by Dandiya PC, Zafer ZYK, Zafer A. Health education & Community Pharmacy. Vallabh Prakashan.
7. Websites of Ministry of Health and Family Welfare, National Health Portal
8. Pharmacists at the Frontlines: A Novel Approach at Combating TB www.ipapharma.org Visit Publications
9. Where There Is No Doctor: A Village Health Care Handbook by David Werner ,2015 updated version
10. Various WHO publications www.who.int

Pharmacology

1. Pharma Satoskar, R.S. and Bhandarkar, S.D. Pharmacology and Pharmacotherapeutics
2. B. Suresh, A Text Book of Pharmacology
3. Derasari and Gandhi's Elements of Pharmacology
4. S.K. Kulkarni, Practical Pharmacology and Clinical Pharmacy
5. H.K. Sharma. Principles of Pharmacology
6. Mary J. Mycek, Lippincott Williams and Wilkins. Lippincott's illustrated Reviews: Pharmacology
7. Tripathi, K.D. Essentials of Medical Pharmacology.
8. Various Drug Information Books like British National Formulary, MIMS, CIMS, Drug Today etc., WHO, NIH Websites

Community Pharmacy and Management

1. Health Education and Community Pharmacy by N.S. Parmar.
2. WHO consultative group report.
3. Drug store and Business management by Mohammed Ali and Jyoti.
4. Handbook of pharmacy – health care. Edt. Robin J Harman. The Pharmaceutical Press
5. Comprehensive Pharmacy Review – Edt. Leon Shargel. Lippincott Williams and Wilkins.
6. Good Pharmacy Practices Training Manual by IPA/CDSCO/WHO India
7. Training Module for Community Pharmacists in TB Care and Control/ by MoH/IPA
8. Hand Book of PharmaSoS, Drugs in Special population- Pregnancy and Lactation, Tobacco free future- Choice is yours: KSPC Publications.
9. Responsible Use of Medicines: A Layman's Handbook, www.ipapharma.org /publications
10. Community Pharmacy Practice around the Globe: Part One: www.ipapharma.org /publications

Biochemistry and Clinical Pathology

1. Essentials of Biochemistry by U. Satyanarayana, Books and Allied (P) Ltd.
2. A Textbook of Biochemistry by A.V.S.S. Rama Rao, UBS Publishers' Distributors Pvt. Ltd.
3. Practical Biochemistry by R.C. Gupta and S. Bhargava.
4. Laboratory manual of Biochemistry by Pattabiraman and Sitaram Acharya

Pharmacotherapeutics

1. Clinical Pharmacy and Therapeutics - Roger and Walker, Churchill Livingstone Publication
2. Clinical Pharmacy and Therapeutics - Eric T. Herfindal, Williams and Wilkins Publication
3. Applied Therapeutics: The clinical Use of Drugs. Lloyd Young and Koda-Kimble MA Lippincott, Williams and Wilkins Publication.
4. Pharmacotherapy: A Pathophysiologic approach - Joseph T. Dipiro et al. Appleton and Lange Publication.
5. National Formulary of India, Indian Pharmacopoeia Commission, Ghaziabad.

Hospital and Clinical Pharmacy

1. A Textbook of Clinical Pharmacy Practice - Essential concepts and skills - Parthasarathi G, Karin Nyfort-Hansen and Milap Nahata. Orient Longman Pvt. Ltd. Hyderabad.
2. Text Book of Hospital and Clinical Pharmacy by Dr. Pratibha Nand and Dr**.** Roop K Khar, Birla publications, New Delhi.
3. Gupta B.K and Gupta R.N., GPP in Hospital Pharmacy, Vallabh Prakashan.
4. Basic skills in interpreting laboratory data - Scott LT, American Society of Health System Pharmacists Inc.
5. Australian drug information- Procedure manual. The Society of Hospital Pharmacists of Australia.

Pharmacy Law and Ethics

1. Text book of Forensic Pharmacy by B.M. Mithal
2. Forensic Pharmacy by B. Suresh
3. Hand book of drug law-by M.L. Mehra
4. A text book of Forensic Pharmacy by N.K. Jain
5. Drugs and Cosmetics Act/Rules by Govt. of India publications.
6. Medicinal and Toilet preparations Act 1955 by Govt. of India publications.
7. Narcotic Drugs and Psychotropic Substances Act by Govt. of India publications
8. Drugs and Magic Remedies Act by Govt. of India publications.
9. CDSCO Website, NPPA Website
10. Books on Drugs and Cosmetic Act by Nilesh Gandhi and Sudhir Deshpande
11. Text Book of Forensic Pharmacy by Dr Guruprasad Mohanta

CURRICULUM FRAMEWORK:
TWO-YEAR B.P.ED. PROGRAMME

NATIONAL COUNCIL FOR TEACHER EDUCATION
Hans Bhawan (Wing-II),
1, Bahadur Shah Zafar Marg,
New Delhi-110 002
www.ncte-india.org

GUIDELINES OF REGULATIONS AND MODEL SYLLABUS STRUCTURE FOR B. P. ED. TWO YEARS PROGRAMME (FOUR SEMESTERS)(CBCS)

(If the University or affiliating body is following choice based credit system, (CBCS) as approved and Circulated by the UGC, the credit hours given in the following curriculum framework need to be considered along with the hours of teaching mentioned for each paper/ activity / course)

(If the University oraffiliatingbody isyet to adopt CBCS, only the hours of teaching mentioned for each paper/ activity / course will be considered, the credit in teaching hours may be ignored)

Preamble: Bachelor of Physical Education (B. P. Ed.) two years (Four Semesters Choice Based Credit System) programme is a professional programme meant for preparing teachers of physical education in classes VI to X and for conducting physical education and sports activities in classes XI and XII.

B. P. Ed. programme shall be designed to integrate the study of childhood, social context of Physical Education, subject knowledge, pedagogical knowledge, aim of Physical Education and communication skills. The programme comprises of compulsory and optional theory as well as practical courses and compulsory school internship.

R.B.P.Ed. 1.Eligibility

Intake, Eligibility and Admission Procedure as per the NCTE norms and standards

R. B.P.Ed. 2. Duration:

The B.P.Ed programme shall be of a duration of two academic years,that is, four semesters. However, the students shall be permitted to complete the programme requirements within a maximum of three years from the date of admission to the programme.

R. B.P.Ed. 3. The CBCS System:

All Programmes shall run on Choice Based Credit System (CBCS). It is an instructional package developed to suit the needs of students, to keep pace with the developments in higher education and the quality assurance expected of it in the light of liberalization and globalization in higher education.

R. B.P.Ed 4. Course:

The term course usually referred to, as ópapersô is a component of a programme. All courses need not carry the same weight. The courses should define learning objectives and learning outcomes. A course may be designed to comprise Lectures/ tutorials/laboratory work/ field work/ outreach activities/ project work/ vocational training/viva/ seminars/ term papers/assignments/ presentations/ self-study etc. or a combination of some of these.

R. B.P.Ed. 5. Courses of Programme:

The B.P.Ed. Programme consists of a number of courses, the term óCourseô applied to indicate a logical part of subject matter of the programme and is invariably equivalent to the subject matter of a ñpaperò in the conventional sense. The following are the various categories of courses suggested for the B.P.Ed. Programme.

Theory:

Core Course:

Elective Course:

Practicum:

Teaching Practices:

R. B.P.Ed.6. Semesters:

An academic year is divided into two semesters. Each semester will consist of 17-20 weeks of academic work equivalent to 100 actual teaching days. The odd semester may be scheduled from May/June to November/Decemberand even semester from November / December to May/June. The institution shall work for a minimum of 36 working hours in a week (five or six days a week).

R. B.P.Ed.7. Working days:

There shall be at least 200 working days per year exclusive of admission and examination processes etc.

R. B.P.Ed 8. Credits:

The term 'Credit' refers to a unit by which the programme is measured. It determines the number of hours of instructions required per week. One credit is equivalent to one hour of teaching (lecture or tutorial) or one and half / two hours of practical work/field work per week.The term 'Credit' refers to the weight given to a course, usually in relation to the instructional hours assigned to it. The total minimum credits, required for completing a B.P.Ed. Programme is 90 credits and for each semester 20 credits.

Provision of Bonus CreditsMaximum 06 Credits in each Semester

Sr. No.	Special Credits for Extra Co-curricular Activities	Credit
1	Sports Achievement at Stale level Competition (Medal Winner) Sports Achievement National level Competition (Medal Winner) Sports participationInternational level Competition	1 2 4
2	Inter Uni. Participation (Any one game)	2
3	Inter College Participation (min. two game)	1
4	National Cadet Corps / National Service Scheme	2
5	Blood donation / Cleanliness drive / Community services /	2
6	Mountaineering ï Basic Camp, Advance Camp / Adventure Activities	2
7	Organization / Officiating ï State / National level in any two game	2
8	News Reposting / Article Writing / book writing / progress report writing	1
9	Research Project	4

Students can earn maximum 06 Bonus credits in each semester by his/her participation in the above mentioned activities duly certified by the Head of the institution / Department. This Bonus credit will be used only to compensate loss of credits in academic activities.

R. B.P.Ed. 9. Examinations:

i. There shall be examinations at the end of each semester, for first semester in the month of November /December: for second semester in the month of May / June. A candidate who does not pass the examination in any course(s) shall be permitted to appear in such failed course(s) in the subsequent examinations to be held in November /December or May / June.

ii. A candidate should get enrolled /registered for the first semester examination. If enrollment/registration is not possible owing to shortage of attendance beyond condonation limit / rules prescribed OR belated joining OR on medical grounds, such candidates are not permitted to proceed to the next semester. Such candidates shall redo the semester in the subsequent term of that semester as a regular student; however, a student of first semester shall be admitted in the second semester, if he/she has successfully kept the term in first semester.

R. B.P.Ed 10 Condonation:

Student must have 75% of attendance in each course for appearing the examination. Students who have 74% to 65% of attendance shall apply for condonation in the prescribed form with the prescribed fee. Students who have 64% to 50% of attendance shall apply for

condonation in prescribed form with the prescribed fee along with the Medical Certificate. Students who have below 50% of attendance are not eligible to appear for the examination.

R. B.P.Ed 11. Pattern of Question Papers:

Question Papers shall have five questions corresponding to four units of each theory course.

B.P.Ed.: Format of Question Paper for 4 Units.

Each question paper shall have five questions. The pattern will be as follows:

Question No.	Description	Marks
1	Answer in detail (Long Question) Or Answer in detail (Long Question) (Form Unit 1)	15
2	Answer in detail (Long Question) Or Answer in detail (Long Question) (Form Unit 2)	15
3	Answer in detail (Long Question) Or Answer in detail (Long Question) (Form Unit 3)	15
4	Write short notes: any two out of four (Form Unit 4)	15
5	M.C.Q. Type Questions (10 out of 12 Que.) (3 Questions. from each unit)	10
	Total	**70**

R. B.P.Ed. 12. Evaluation:

The performance of a student in each course is evaluated in terms of percentage of marks with a provision for conversion to grade point. Evaluation for each course shall be done by a continuous internal assessment (CIA) by the concerned course teacher as well as by end semester examination and will be consolidated at the end of course. The components for continuous internal assessment are;

One Test	15 Marks
Seminar / Quiz	5 Marks
Assignments	5 Marks
Attendance	5 Marks
Total	30 Marks

Attendance shall be taken as a component of continuous assessment, although the students should have minimum 75% attendance in each course. In addition to continuous evaluation component, the end semester examination, which will be written type examination of at least 3 hours duration, would also form an integral component of the evaluation. The ratio of marks to be allotted to continuous internal assessment and to end semester examination is 30:70. The evaluation of practical work, wherever applicable, will also be based on continuous internal assessment and on an end-semester practical examination.

R. B.P.Ed. 13. Minimum Passing Standard:

The minimum passing standard for CIA (Continuous Internal Assessment) and External Examinations shall be 40%, i.e. 12 marksout of 30 marks and 28 marks out of 70 marks respectively for theory courses.The minimum passing for both CIA & external examination shall be 50%,i.e. 15 marks out of 30 and 35 marks out of 70 marks for the practical courses.

R. B.P.Ed 14. Grading:

Once the marks of the CIA (Continues Internal Assessment) and SEA (Semester End Assesment) for each of the courses are available, both (CIA and SEA) will be added. The marks thus obtained for each of the courses will then be graded as per details provided in R. B.P.Ed. 17 from the first semester onwards the average performance within any semester from the first semester is indicated by Semester Grade Point Average (SGPA) while continuous performance (including the performance of the previous semesters also) starting from the first semesteris indicated by Cumulative Grade Point Average (CGPA). These two are calculated by the following formula:

$$\text{SGPA} = \frac{\sum_{i=1}^{n} C_i G_i}{\sum_{i=1}^{n} C_i}$$

$$\text{CGPA} = \frac{\sum_{j=1}^{N} \text{SGPA}_j}{N}$$

Where C*i* is the Credit earned for the course is in any semester; G*i* is the Grade point obtained by the student for the course *i* and *n* number of courses obtained in that semester; $\text{SGPA}_j$is SGPA of semester *j* and *N* number of semester. Thus CGPA is average of SGPA of all the semesters starting from the first semester to the current semester.

R. B.P.Ed. 15. Classification of Final Results:

For the purpose of declaring a candidate to have qualified for the Degree of Bachelor of Physical Education in the First class / Second class / Pass class or First class with Distinction, the

marks and the corresponding CGPA earned by the candidate in Core Courses will be the criterion. It is further provided that the candidate should have scored the First / Second Class separately in both the grand total and end Semester (External) examinations.

R. B.P.Ed.16. Award of the B.P.Ed. Degree:

A candidate shall be eligible for the award of the degree of the B.P.Ed. only if he/she has earned the minimum required credit including Bonus Credits of the programme prescribed above.

R. B.P.Ed.17. Letter Grades and Grade Points:

i. Two methods-relative grading or absolute gradingï have been in vogue for awarding grades in a course. The relative grading is based on the distribution (usually normal distribution) of marks obtained by all the students in the course and the grades are awarded based on a cut-off mark or percentile. Under the absolute grading, the marks are converted to grades based on pre-determined class intervals. To implement the following grading system, the colleges and universities can use any one of the above methods.

ii. The grades for each course would be decided on the basis of the percentage marks obtained at the end-semester external and internal examinations as per following table:

Percentage	Grade Point	Latter Grade	Description	Classification of final result
85 & above	8.5-10.0	O	Outstanding	First class with Distinction
70-84.99	7.0-8.49	A^+	Excellent	
60-69.99	6.0-6.99	A	Very Good	First Class
55-59.99	5.5-5.99	B+	Good	Higher Second Class
50-54.99	5.0-5.49	B	Above Average	Second Class
40-49.99	4.0-4.99	C	Average	Pass Class
Below 40	0.0	F	Fail/ Dropped	Dropped
	0	AB	Absent	

R. B.P.Ed.18. Grade Point Calculation

Calculation of **Semester Grade Point Average (SGPA)** and **Credit Grade Point (CGP)** and declaration of class for B. P. Ed. Programme.

The credit grade points are to be calculated on the following basis:

$$\text{SGPA} = \frac{\sum_{\text{course}} C_i G_i}{\sum_{\text{course}} C_i}$$

Example – I

Marks obtained by Student in course CC101 = 65/100

Percentage of marks = 65 %

Grade from the conversion table is = A

Grade Point = 6.0 + 5 (0.99/9.99)
= 6.0 + 5x0.1
= 6.0+ 0.5
=6.5
The Course Credits = 04
Credits Grade Point (CGP) = 6.5 × 04 = 26

The semester grade point average (SGPA) will be calculated as a weighted average of all the grade point of the semester courses. That is Semester grade point average (SGPA) = (sum of grade points of all eight courses of the semester) / total credit of the semester as per example given below:

SEMESTER-1

Courses No.	Credit	Marks out of 100 (%)	Grade	Grade Point	Credit Grade point
CC-101	4	65	A	6.5	26
CC-102	4	60	A	6	24
CC-103	4	62	A	6.2	24.8
EC-101/EC-102	4	57	B+	5.7	22.8
PC-101	4	55	B+	5.5	22
PC-102	4	72	A+	7.2	28.8
PC-103	4	66	A	6.6	26.4
PC - 104	4	72	A+	7.2	28.8
	32				203.6

Examples: Conversion of marks into grade points

CC-101 65 = 60 + 5 = 6.0 + 5 x (0.99 / 9.99) = 6.0 + 5 x 0.1 = 6.0 + 0.5 = 6.5
CC-102 60 = 6.0
CC-103 62 = 60 + 2 =6.0 + 2 x (0.99/9.99) = 6.0 + 2 x 0.1 = 6.0 + 0.2 = 6.2
EC-101/EC-102 57 = 55 + 2 = 5.5 + 2 x (0.49 / 4.99) = 5.5 + 2 x 0.1 = 5.5 + 0.2 = 5.7
PC-101 55 = 5.5
PC-102 72 = 70 + 2 = 7.0+ 2 x (1.49 /14.99) = 7.0 + 2 x 0.1 = 7.0 +0.2 = 7.2
PC-103 66 = 60 + 6 = 6.0 + 6 x (0.99 / 9.99) = 6.0 + 6 x 0.1 = 6.0 + 0.6 = 6.6
PC – 104 72 = 70 + 2 = 7.0+ 2 x (1.49 /14.99) = 7.0 + 2 x 0.1 = 7.0 +0.2 = 7.2

SEMESTER GRADE POINT AVERAGE (SGPA) = Total Credit Grade Points
= 203.6 /32 = 6.3625
SGPA Sem. I = 6.3625
At the end of Semester-1
Total SGPA = 6.3625
Cumulative Grade Point Average (CGPA) = 6.3625/1 = 6.3625

CGPA = 6.66875, Grade = A, Class = First Class

SEMESTER-2

Courses No.	Credit	Marks out of 100 (%)	Grade	Grade Point	Credit Grade point
CC-201	4	76	A+	7.6	30.4
CC-202	4	64	A	6.4	25.6
CC-203	4	59	B+	5.9	23.6
EC-201/EC-202	4	80	A+	8	32
PC-201	4	49	C	4.9	19.6
PC-202	4	64	A	6.4	25.6
PC-203	4	55	B+	5.5	22
TP - 201	4	72	A+	7.2	28.8
	32				207.6

SGPA Sem. II = 6.4875

At the end of Semester-2

Total SGPA for two Semesters = 12.85
Cumulative Grade Point Average (CGPA) = 12.85/2 = 6.425
CGPA = 6.66875, Grade = A, Class = First Class

SEMESTER-3

Courses No.	Credit	Marks out of 100 (%)	Grade	Grade Point	Credit Grade point
CC-301	4	64	A	6.4	25.6
CC-302	4	64	A	6.4	25.6
CC-303	4	59	B+	5.9	23.6
EC-301/EC-302	4	81	A+	8.1	32.4
PC-301	4	49	C	4.9	19.6
PC-302	4	64	A	6.4	25.6
PC-303	4	68	A	6.8	27.2
TP - 301	4	75	A+	7.5	30
	32				209.6

SGPA Sem. III = 6.55
At the end of Semester-3

Total SGPA for three Semesters = 19.4
Cumulative Grade Point Average (CGPA) = 19.4/3 = 6.466667
CGPA = 6.66875, Grade = A, Class = First Class

SEMESTER-4

Courses No.	Credit	Marks out of 100 (%)	Grade	Grade Point	Credit Grade point
CC-401	4	83	A+	8.3	33.2
CC-402	4	76	A+	7.6	30.4
CC-403	4	59	B+	5.9	23.6
EC-401/EC-402	4	81	A+	8.1	32.4
PC-401	4	49	C	4.9	19.6
PC-402	4	78	A+	7.8	31.2
TP-401	4	81	A+	8.1	32.4
TP-402	4	75	A+	7.5	30
	32				232.8

SGPA Sem. IV = 7.275

At the end of Semester-4

Total SGPA for all the four semesters = 26.675

Cumulative Grade Point Average (CGPA) = 26.675 /4 = 6.66875

CGPA = 6.66875, Grade = A, Class = First Class

Note:

(1) SGPA is calculated only if the candidate passes in all the courses i.e. get minimum C grade in all the courses.

(2) CGPA is calculated only when the candidate passes in all the courses of all the previous and current semesters.

(3)The cumulative grade point average will be calculated as the average of the SGPA of all the semesters continuously, as shown above.

(4)For the award of the class, CGPA shall be calculated on the basis of:

(a) Marks of each Semester EndAssesment And

(b) Marks of each Semester Continuous Internal Assessment for each course. The final Class for B.P.Ed. Degree shall be awarded on the basis of last CGPA (grade) fromall theone to four semester examinations.

R. B.P.Ed.19. Grievance Redressal Committee:

The college/department shall form a Grievance Redressal Committee for each course in each college/department with the course teacher / Principal / Director and the HOD of the faculty as the members. This Committee shall solve all grievances of the students.

R. B.P.Ed.20. Revision of Syllabi:

1. Syllabi of every course should be revised according to the NCTE.
2. Revised Syllabi of each semester should be implemented in a sequential way.
3. In courses, where units / topics related to governmental provisions, regulations or laws, that change to accommodate the latest developments, changes or corrections are to be made consequentially as recommended by the Academic Council.

4. All formalities for revisions in the syllabi should be completed before the end of the semester for implementation of the revised syllabi in the next academic year.
5. During every revision, up to twenty percent of the syllabi of each course should be changed so as to ensure the appearance of the students who have studied the old (unrevised) syllabi without any difficulties in the examinations of revised syllabi.
6. In case, the syllabus of any course is carried forward without any revision, it shall also be counted as revised in the revised syllabi.

Semester - I

PartA:TheoreticalCourse						
Course Code	TitleofthePapers	Total Hours	Credit	Internal Marks	External Marks	Total Marks
CoreCourse						
CC-101	History, Principles and foundation of Physical Education	4	4	30	70	100
CC-102	Anatomy and Physiology	4	4	30	70	100
CC-103	Health Education and Environmental Studies	4	4	30	70	100
Elective Course (Anyone)						
EC-101	Olympic Movement	4	4	30	70	100
EC-102	Officiating and Coaching					
Part–B PracticalCourse						
PC-101	Track and Field (Running Events)	**6**	**4**	30	70	100
PC-102	Swimming/Gymnastics/ Shooting	**6**	**4**	30	70	100
PC-103	Indigenous Sports: Kabaddi / Malkhambh/ lezim / March past	**6**	**4**	30	70	100
PC - 104	Mass Demonstration Activities: Kho-Kho / dumbbells / tipri / wands / hoop /umbrella	**6**	**4**	30	70	100
Total		40	32	240	560	800

Note: Total Number of hours required to earn 4 credits foreach Theory Course are 68-80 hours per semester whereas 102-120 hours foreach Practicum Course.

Semester - II

PartA:TheoreticalCourse						
Course Code	TitleofthePapers	Total Hours	Credit	Internal Marks	External Marks	Total Marks
CoreCourse						
CC-201	Yoga Education	4	4	30	70	100
CC-202	Educational Technology and Methods of Teaching in Physical Education	4	4	30	70	100
CC-203	Organization and Administration	4	4	30	70	100
Elective Course (Anyone)						
EC-201	Contemporary issues in physical education, fitness and wellness	4	4	30	70	100
EC-202	Sports Nutrition and Weight Management					
Part–B PracticalCourse						
PC-201	Track and Field (Jumping Events)	**6**	**4**	30	70	100
PC-202	Yoga/Aerobics/ Gymnastics/ Swimming	**6**	**4**	30	70	100
PC-203	Racket Sports: Badminton/ Table Tennis/ Squash/ Tennis	**6**	**4**	30	70	100
Part – C Teaching Practices						
TP - 201	Teaching Practices (05lessons in class room teaching and 05 lessons in outdoor activities)	**6**	**4**	30	70	100
Total		40	32	240	560	800

Note: Total Number of hours required to earn 4 credits foreach Theory Course are 68-80 hours per semester whereas 102-120 hours for each Practicum Course.

Semester - III

PartA:TheoreticalCourse						
Course Code	TitleofthePapers	Total Hours	Credit	Internal Marks	External Marks	Total Marks
CoreCourse						
CC-301	Sports Training	4	4	30	70	100
CC-302	Computer Applications in Physical Education	4	4	30	70	100
CC-303	Sports Psychology and Sociology	4	4	30	70	100
Elective Course (Anyone)						
EC-301	Sports Medicine, Physiotherapy and Rehabilitation	4	4	30	70	100
EC-302	Curriculum Design					
Part–B PracticalCourse						
PC-301	Track and Field (Throwing Events)	**6**	**4**	30	70	100
PC-302	Combative Sports: Martial Art/ Karate/ Judo/ Fencing/ Boxing/ Taekwondo/ Wrestling (Any two out of these)	**6**	**4**	30	70	100
PC-303	Team Games: Baseball/ Cricket/ Football/ Hockey/ Softball/ Volleyball/ Handball/ Basketball/ Netball (Any two of these)	**6**	**4**	30	70	100
Part – C Teaching Practices						
TP - 301	Teaching Practice: (Teaching Lesson Plans for Racket Sport/ Team Games/Indigenous Sports) (out of 10 lessons 5 internal and 5 external at practicing school)	**6**	**4**	30	70	100
Total		40	32	240	560	800

Note: Total Number of hours required to earn 4 credits foreach Theory Course are 68-80 hours per semester whereas 102-120 hours for each Practicum Course.

Semester - IV

PartA:TheoreticalCourse						
Course Code	TitleofthePapers	Total Hours	Credit	Internal Marks	External Marks	Total Marks
CoreCourse						
CC-401	Measurement and Evaluation in Physical Education	4	4	30	70	100
CC-402	Kinesiology and Biomechanics	4	4	30	70	100
CC-403	Research and Statistics in Physical Education	4	4	30	70	100
Elective Course (Anyone)						
EC-401	Theory of sports and game	4	4	30	70	100
EC-402	Sports Management					
Part–B PracticalCourse						
PC-401	Track and Field / Swimming / Gymnastics (Any one out of three)	**6**	**4**	30	70	100
PC-402	Kabaddi/ Kho-Kho/ Baseball/ Cricket/ Football/Hockey/Softball/ Volleyball/ Handball/ Basketball/ Netball/ Badminton/ Table Tennis/ Squash/ Tennis (Any Two of these)	**6**	**4**	30	70	100
Part – C Teaching Practices						
TP-401	Sports specialization: Coaching lessons Plans (One for Sports 5 lessons)	**6**	4	30	70	100
TP-402	Games specialization: Coaching lessons Plans (One for Games 5 lessons)	**6**	4	30	70	100
Total		40	32	240	560	800
		160	128	960	2240	3200

Note: Total Number of hours required to earn 4 credits foreach Theory Course are 68-80 hours per semester whereas 102-120 hours for each Practicum Course.

SCHEME OF EXAMINATION

SEMESTER - I

Paper	Subject	Internal	External	Total Marks
	THEORY (400)			
CC-101	History, Principles and foundation of Physical Education	30	70	100
CC-102	Anatomy and Physiology	30	70	100
CC-103	Health Education and Environmental Studies	30	70	100
EC-101/102	Olympic Movement/Officiating and Coaching (Elective)	30	70	100
	PRACTICAL (400)			
PC-101	Track and Field (Running Events)	30	70	100
PC-102	Swimming/Gymnastics/Shooting	30	70	100
PC-103	Indigenous Sports: Kabaddi/ Malkhambh/ lezim / March past (Any of one out of these)	30	70	100
PC-104	Mass Demonstration Activities: Kho-Kho / dumbbells / tipri / wands / hoop /umbrella (Any one out of these)	30	70	100
	Total	**240**	**560**	**800**

SEMESTER -II

Paper	Subject	Internal	External	Total Marks
	THEORY (400)			
CC-201	Yoga Education	30	70	100
CC-202	Educational Technology and Methods of Teaching in Physical Education	30	70	100
CC-203	Organization and Administration	30	70	100
EC-201/202	Contemporary issues in physical education, fitness and wellness/ Sports Nutrition and Weight Management (Elective)	30	70	100
	PRACTICAL (300)			
PC-201	Track and Field (Jumping Events)	30	70	100
PC-202	Yoga/Aerobics / Swimming / Gymnastics (Any of the two out of these)	30	70	100
PC-203	Racket Sports: Badminton/ Table Tennis/ Squash/ Tennis (Any of the two out of these)	30	70	100
	TEACHING PRACTICE (100)			
TP-201	Teaching Practice (Classroom and outdoor)	30	70	100
	Total	**240**	**560**	**800**

SEMESTER –III

Paper	Subject	Internal	External	Total Marks
	THEORY (400)			
CC-301	Sports Training	30	70	100
CC-302	Computer Applications in Physical Education	30	70	100
CC-303	Sports Psychology and Sociology	30	70	100
EC-301/302	Sports Medicine, Physiotherapy and Rehabilitation/Curriculum Design (Elective)	30	70	100
	PRACTICAL (300)			
PC-301	Track and Field (Throwing Events)	30	70	100
PC-302	Combative Sports : Martial Art, Karate, Judo, Fencing, Boxing, Taekwondo, Wrestling (Any two out of these)	30	70	100
PC-303	Team Games: Baseball, Cricket, Football, Hockey, Softball, Volleyball, Handball, Basketball, Netball (Any two of these)	30	70	100
	TEACHING PRACTICE (100)			
TP-301	Teaching Practice (Teaching Lesson Plans for Racket Sport/ Team Games/Indigenous Sports)	30	70	100
	Total	**240**	**560**	**800**

SEMESTER -IV

Paper	**Subject**	**Internal**	**External**	**Total Marks**
	THEORY (400)			
CC-401	Measurement and Evaluation in Physical Education	30	70	100
CC-402	Kinesiology and Biomechanics	30	70	100
CC-403	Research and Statistics in Physical Education	30	70	100
EC-401/402	Theory of sports and games(Specifically sports and games specialization)/Sports Management (Elective)	30	70	100
	PRACTICAL (200)			
PC-401	Track and Field/Swimming /Gymnastics (Any of one out of these)	30	70	100
PC-402	Kabaddi/ Kho-Kho/ Baseball/ Cricket/ Football/Hockey/Softball/ Volleyball/ Handball/ Basketball/ Netball/ Badminton/ Table Tennis/ Squash/ Tennis (Any of one out of these)	30	70	100
	TEACHING PRACTICE (200)			
TP-401	Sports Specialization: Coaching lessons Plans Track and Field/Swimming /Gymnastics (Any of one out of these)	30	70	100
TP-402	Game specialization Coaching lessons: Kabaddi/ Kho-Kho/ Baseball/ Cricket/Football/Hockey /Softball/ Volleyball/ Handball/ Basketball/ Netball/ Badminton/ Table Tennis/ Squash/ Tennis (Any of one out of these)	30	70	100
	Total	**240**	**560**	**800**

B. P. Ed. – Outline of Syllabus

Semester – I

Theory Courses

CC-101 HISTORY, PRINCIPLES AND FOUNDATION OF PHYSICAL EDUCATION

Unit – 1: Introduction

- Meaning, Definition and Scope of Physical Education
- Aims and Objective of Physical Education
- Importance of Physical Education in present era.
- Misconceptions about Physical Education.
- Relationship of Physical Education with General Education.
- Physical Education as an Art and Science.

Unit- 2 – Historical Development of Physical Education in India

- Indus Valley Civilization Period. (3250 BC ï 2500 BC)
- Vedic Period (2500 BC ï 600 BC)
- Early Hindu Period (600 BC ï 320 AD) and Later Hindu Period (320 AD ï 1000 AD)
- Medieval Period (1000 AD ï 1757 AD)
- British Period (Before 1947)
- Physical Education in India (After 1947)
- Contribution of Akhadas and Vyayamshals
- Y.M.C.A. and its contributions.

Unit- 3- Foundation of Physical Education

- Philosophical foundation:
- Idealism, Pragmatism, Naturalism, Realism, Humanism, Existentialism and Indian Philosophy and Culture.
- Fitness and wellness movement in the contemporary perspectives
- Sports for all and its role in the maintenance and promotion of fitness.

Unit-4- Principles of Physical Education

- Biological
    - Growth and development
    - Age and gender characteristics
    - Body Types
    - Anthropometric differences
- Psychological
    - Learning types, learning curve
    - Laws and principles of learning
    - Attitude, interest, cognition, emotions and sentiments

- Sociological
    - Society and culture
    - Social acceptance and recognition
    - Leadership
    - Social integration and cohesiveness

References:

Bucher, C. A. (n.d.) *Foundation of physical education.* St. Louis: The C.V. Mosby Co.

Deshpande, S. H. (2014). *Physical Education in Ancient India*. Amravati: Degree college of Physical education.

Mohan, V. M. (1969). *Principles of physical education.* Delhi: Metropolitan Book Dep.

Nixon, E. E. & Cozen, F.W. (1969). *An introduction to physical education*. Philadelphia: W.B. Saunders Co.

Obertuffer, (1970). *Delbert physical education*. New York: Harper & Brothers Publisher.

Sharman, J. R. (1964). *Introduction to physical education*. New York: A.S. Barnes & Co.

William, J. F. (1964). *The principles of physical education*. Philadelphia: W.B. Saunders Co.

Semester I

Theory Courses

CC-102 ANATOMY AND PHYSIOLOGY

UNIT-I

- Brief Introduction of Anatomy and physiology in the field of Physical Education.
- Introduction of Cell and Tissue.
- The arrangement of the skeleton ï Function - of the skeleton ï Ribs and Vertebral column and the extremities ï joints of the body and their types
- Gender differences in the skeleton.
- Types of muscles.

UNIT-II

- **Blood and circulatory system:** Constituents of blood and their function ï Blood groups and blood transfusion, clotting of blood, the structure of the heart-properties of the heart muscle, circulation of blood, cardiac cycle, blood pressure, Lymph and Lymphatic circulation. Cardiac output.
- **The Respiratory system:** The Respiratory passage ï the lungs and their structure and exchange of gases in the lungs, mechanism of respiration (internal and external respiration) lung capacity, tidal volume.
- **The Digestive system:** structure and functions of the digestive system, Digestive organs, Metabolism,
- **The Excretory system:** Structure and functions of the kidneys and the skin.
- **The Endocrine glands:** Functions of glands pituitary, Thyroid, Parathyroid. Adrenal, Pancreatic and the sex glands.
- **Nervous systems:** Function of the Autonomic nervous system and Central nervous system. Reflex Action,
- **Sense organs:** A brief account of the structure and functions of the Eye and Ear.

UNIT-III

- Definition of physiology and its importance in the field of physical education and sports.
- Structure, Composition, Properties and functions of skeletal muscles.
- Nerve control of muscular activity:
  - Neuromuscular junction
  - Transmission of nerve impulse across it.
- Fuel for muscular activity
- Role of oxygen- physical training, oxygen debt, second wind, vital capacity.

UNIT-IV

- Effect of exercise and training on cardiovascular system.
- Effect of exercise and training on respiratory system.
- Effect of exercise and training on muscular system
- Physiological concept of physical fitness, warming up, conditioning and fatigue.
- Basic concept of balanced diet ï Diet before, during and after competition.

References:

Gupta, A. P. (2010). *Anatomy and physiology.* Agra: SumitPrakashan.

Gupta, M. and Gupta, M. C. (1980). *Body and anatomical science.* Delhi: Swaran Printing Press.

Guyton, A.C. (1996). Textbook of Medical Physiology, 9th edition. Philadelphia: W.B. Saunders.

Karpovich, P. V. (n.d.). *Philosophy of muscular activity.* London: W.B. Saunders Co.

Lamb, G. S. (1982). Essentials of exercise physiology. Delhi: Surjeet Publication.

Moorthy, A. M. (2014). *Anatomy physiology and health education.*Karaikudi: Madalayam Publications.

Morehouse, L. E. & Miller, J. (1967). *Physiology of exercise*. St. Louis: The C.V. Mosby Co.

Pearce, E. C. (1962). *Anatomy and physiology for nurses.* London: Faber & Faber Ltd.

Sharma, R. D. (1979). *Health and physical education*, Gupta Prakashan.

Singh, S. (1979). *Anatomy of physiology and health education*. Ropar: Jeet Publications.

Semester I

Theory courses

CC-103 HEALTH EDUCATION AND ENVIRONMENTAL STUDIES

Unit – I Health Education

- Concept, Dimensions, Spectrum and Determinants of Health
- Definition of Health, Health Education, Health Instruction, Health Supervision
- Aim, objective and Principles of Health Education
- Health Service and guidance instruction in personal hygiene

Unit – II Health Problems in India

- Communicable and Non Communicable Diseases
- Obesity, Malnutrition, Adulteration in food, Environmental sanitation, Explosive Population,
- Personal and Environmental Hygiene for schools
- Objective of school health service, Role of health education in schools
- Health Services ï Care of skin, Nails, Eye health service, Nutritional service, Health appraisal, Health record, Healthful school environment, first- aid and emergency care etc.

Unit – III Environmental Science

- Definition, Scope, Need and Importance of environmental studies.
- Concept of environmental education, Historical background of environmental education,
- Celebration of various days in relation with environment.
- Plastic recycling & probation of plastic bag / cover.
- Role of school in environmental conservation and sustainable development.

Unit – IVNatural Resources and related environmental issues:

- Water resources, food resources and Land resources
- Definition, effects and control measures of:
- Air Pollution, Water Pollution, Soil Pollution, Noise Pollution, Thermal Pollution
- Management of environment and Govt. policies , Role of pollution control board.

References:

Agrawal, K.C. (2001). *Environmental biology*.Bikaner: Nidhi publishers Ltd.

Frank, H. &Walter, H., (1976). *Turners school health education*. Saint Louis: The C.V. Mosby Company.

Nemir, A. (n.d.). The school health education. New York:Harber and Brothers.

Odum, E.P. (1971). *Fundamental of ecology*. U.S.A.: W.B. Saunders Co.

Semester – I

Theory courses

EC-101 OLYMPIC MOVEMENT (ELECTIVE)

Unit – I Origin of Olympic Movement

- Philosophy of Olympic movement
- The early history of the Olympic movement
- The significant stages in the development of the modern Olympic movement
- Educational and cultural values of Olympic movement

Unit – IIModern Olympic Games

- Significance of Olympic Ideals, Olympic Rings, Olympic Flag
- Olympic Protocol for member countries
- Olympic Code of Ethics
- Olympism in action
- Sports for All

Unit – III Different Olympic Games

- Para Olympic Games
- Summer Olympics
- Winter Olympics
- Youth Olympic Games

Unit – IV Committees of Olympic Games

- International Olympic Committee - Structure and Functions
- National Olympic committees and their role in Olympic movement
- Olympic commission and their functions
- Olympic medal winners of India

Reference:

Osborne, M. P. (2004). *Magictree house fact tracker: ancient greece and the olympics: a nonfiction companion to magic tree house: hour of the Olympics. New York:* Random House Books for Young Readers.

Burbank, J. M., Andranovich, G. D. &Heying Boulder, C. H. (2001). Olympic dreams: the impact of mega-events on local politics: Lynne Rienner

Semester – I

Theory courses

EC-102 OFFICIATING AND COACHING (Elective)

Unit- I: Introduction of Officiating and coaching

- Concept of officiating and coaching
- Importance and principles of officiating
- Relation of official and coach with management, players and spectators
- Measures of improving the standards of officiating and coaching

Unit- II: Coach as a Mentor

- Duties of coach in general, pre, during and post game.
- Philosophy of coaching
- Responsibilities of a coach on and off the field
- Psychology of competition and coaching

Unit- III: Duties of Official

- Duties of official in general, pre, during and post game.
- Philosophy of officiating
- Mechanics of officiating ï position, singles and movement etc.
- Ethics of officiating

Unit- IV: Qualities and Qualifications of Coach and Official

- Qualities and qualification of coach and official
- General rules of games and sports
- Eligibility rules of intercollegiate and inter-university tournaments, preparation of TA, DA bills
- Integrity and values of sports

Reference Books:

Bunn, J. W. (1968). *The art of officiating sports*. Englewood cliffs N.J. Prentice Hall.

Bunn, J. W. (1972). *Scientific principles of coaching.* Englewood cliffs N. J. Prentice Hall.

Dyson, G. H. (1963). *The mechanics of athletics*. London: University of London Press Ltd.

Dyson, G. H. (1963). *The mechanics of Athletics*. London: University of London Press Ltd.

Lawther, J.D. (1965). *Psychology of coaching.* New York: Pre. Hall.

Singer, R. N. (1972). *Coaching, athletic & psychology*.New York: M.C. Graw Hill.

Semester – II

Theory Courses

CC-201 YOGA EDUCATION

Unit – I: Introduction

- Meaning and Definition of Yoga
- Aims and Objectives of Yoga
- Yoga in Early Upanisads
- The Yoga Sutra: General Consideration
- Need and Importance of Yoga in Physical Education and Sports

Unit - II: Foundation of Yoga

- The Astanga Yoga: Yama, Niyama, Asana, Pranayama, Pratyahara, Dharana, Dhyana and Samadhi
- Yoga in the Bhagavadgita - Karma Yoga, Raja Yoga, Jnana Yoga and Bhakti Yoga

Unit - III Asanas

- Effect of Asanas and Pranayama on various system of the body
- Classification of asanas with special reference to physical education and sports
- Influences of relaxtive, meditative posture on various system of the body
- Types of Bandhas and mudras
- Type of kriyas

Unit – IVYoga Education

- Basic, applied and action research in Yoga
- Difference between yogic practices and physical exercises
- Yoga education centers in India and abroad
- Competitions in Yogasanas

References:

Brown, F. Y.(2000). *How to use yoga*. Delhi:Sports Publication.

Gharote, M. L. &Ganguly, H. (1988). *Teaching methods for yogic practices*.Lonawala: Kaixydahmoe.

Rajjan, S. M. (1985). *Yoga strenthening ofrelexation for sports man.* New Delhi:Allied Publishers.

Shankar,G.(1998). *Holistic approach of yoga.* New Delhi:Aditya Publishers.

Shekar,K. C. (2003). *Yoga for health*. Delhi: Khel Sahitya Kendra.

Semester – II

Theory Courses

CC-202 EDUCATIONAL TECHNOLOGY AND METHODS OF TEACHING N PHYSICAL EDUCATION

Unit – I Introduction

- Education and Education Technology- Meaning and Definitions
- Types of Education- Formal, Informal and Non- Formal education.
- Educative Process
- Importance of Devices and Methods of Teaching.

Unit ï II Teaching Technique

- Teaching Technique ï Lecture method, Command method, Demonstration method, Imitation method, project method etc.
- Teaching Procedure ï Whole method, whole ï part ï whole method, part ï whole method.
- Presentation Technique ï Personal and technical preparation
- Command- Meaning, Types and its uses in different situations.

Unit – III Teaching Aids

- Teaching Aids ï Meaning, Importance and its criteria for selecting teaching aids.
- Teaching aids ï Audio aids, Visual aids, Audio ï visual aids, Verbal, Chalk board, Charts, Model, Slide projector, Motion picture etc
- Team Teaching ï Meaning, Principles and advantage of team teaching.
- Difference between Teaching Methods and Teaching Aid.

Unit – IV Lesson Planning and Teaching Innovations

- Lesson Planning ï Meaning, Type and principles of lesson plan.
- General and specific lesson plan.
- Micro Teaching ï Meaning, Types and steps of micro teaching.
- Simulation Teaching - Meaning, Types and steps of simulation teaching.

Reference:

Bhardwaj, A. (2003). *New media of educational planning*.New Delhi:Sarup of Sons.

Bhatia,& Bhatia,(1959). *The principles and methods of teaching*.New Delhi: Doaba House.

Kochar, S.K. (1982). *Methods and techniques of teaching*.New Delhi: Sterling Publishers Pvt. Ltd.

Sampath, K.,Pannirselvam, A. &Santhanam, S. (1981). *Introduction to educational technology*.New Delhi: Sterling Publishers Pvt. Ltd.

Walia, J.S. (1999). *Principles and methods of education*.Jullandhar:Paul Publishers.

Semester – II

Theory Courses

CC-203 ORGANZATION AND ADMINISTRATION IN PHYSICAL EUCATION

Unit – I: Organization and administration

- Meaning and importance of Organization and Administration in physical education
- Qualification and Responsibilities of Physical Education teacher and pupil leader
- Planning and their basic principles,
- Program planning: Meaning, Importance, Principles of program planning in physical education.
- Functions of Planning, organizing, staffing, directing, communicating, co-ordination, controlling, evaluating and innovating.

Unit- II: Office Management, Record, Register & Budget

- Office Management: Meaning, definition, functions and kinds of office management
- Records and Registers: Maintenance of attendance Register, stock register, cash register, physical efficiency record, Medical examination Record.
- Budget: Meaning, Importance of Budget making,
- Criteria of a good Budget, Sources of Income, Expenditure, Preparation of Budget.

Unit-III: Facilities, & Time-Table Management

- Facilities and equipment management: Types of facilities Infrastructure-indoor, out door.
- Care of school building, Gymnasium, swimming pool, Play fields, Play grounds
- Equipment: Need, importance, purchase, care and maintenance.
- Time Table Management: Meaning, Need, Importance and Factor affecting time table.

Unit-IV:Competition Organization

- Importance of Tournament,
- Types of Tournament and its organization structure - Knock-out Tournaments, League or Round Robin Tournaments, Combination Tournament and challenge Tournament.
- Organization structure of Athletic Meet
- Sports Event Intramurals & Extramural Tournament planning

References:

Broyles, F. J. &Rober, H. D. (1979). *Administration of sports, Athletic programme: A Managerial Approach.* New York: Prentice hall Inc.

Bucher, C. A. (1983). *Administration of Physical Education and Athletic programme.*St. Lolis: The C.V. Hosby Co.

Kozman, H.C. Cassidly, R. & Jackson, C. (1960).*Methods in Physical Education*. London: W.B. Saunders Co.

Pandy, L.K. (1977). *Methods in Physical Education.*Delhe: Metropolitan Book Depo.

Sharma, V.M. & Tiwari, R.H.: (1979). *Teaching Methods in Physical Education.* Amaravati: Shakti Publication.

Thomas, J. P.(1967). *Organization & administration of Physical Education*. Madras: Gyanodayal Press.

Tirunarayanan, C. &Hariharan, S. (1969). *Methods in Physical Education.*Karaikudi: South India Press.

Voltmer, E. F. &Esslinger, A. A. (1979).*The organization and administration of Physical Education.* New York: Prentice Hall Inc.

Semester – II

Theory Courses

EC-201 CONTEMPORARY ISSUES IN PHYSICAL EDUCATION, FITNESS AND WELLNESS (ELECTIVE)

Unit – I Concept of Physical Education and Fitness

- Definition, Aims and Objectives of Physical Education, fitness and Wellness
- Importance and Scope of fitness and wellness
- Modern concept of Physical fitness and Wellness
- Physical Education and its Relevance in Inter Disciplinary Context.

Unit – II Fitness, Wellness and Lifestyle

- Fitness ï Types of Fitness and Components of Fitness
- Understanding of Wellness
- Modern Lifestyle and Hypo kinetic Diseases ï Prevention and Management
- Physical Activity and Health Benefits

Unit – III Principles of Exercise Program

- Means of Fitness development ï aerobic and anaerobic exercises
- Exercises and Heart rate Zones for various aerobic exercise intensities
- Concept of free weight Vs Machine, Sets and Repetition etc
- Concept of designing different fitness training program for different age group.

Unit – IV Safety Education and Fitness Promotion

- Health and Safety in Daily Life
- First Aid and Emergency Care
- Common Injuries and their Management
- Modern Life Style and Hypo-kinetic Disease ï Prevention and Management

References:

Difiore, J.(1998). *Complete guide to postnatal fitness.* London: A & C Black,.

Giam, C.K & The, K.C. (1994). *Sport medicine exercise and fitness.* Singapore: P.G. Medical Book.

Mcglynn, G., (1993). *Dynamics of fitness.* Madison: W.C.B Brown.

Sharkey, B. J.(1990). *Physiology of fitness,* Human Kinetics Book.

Semester II

Theory courses

EC-202 SPORTS NUTRITION AND WEIGHT MANAGEMENT (ELECTIVE)

Unit – I Introduction to Sports Nutrition

- Meaning and Definition of Sports Nutrition
- Basic Nutrition guidelines
- Role of nutrition in sports
- Factor to consider for developing nutrition plan

Unit – II Nutrients: Ingestion to energy metabolism

- Carbohydrates, Protein, Fat ï Meaning, classification and its function
- Role of carbohydrates, Fat and protein during exercise
- Vitamins, Minerals, Water ï Meaning, classification and its function
- Role of hydration during exercise, water balance, Nutrition ï daily caloric requirement and expenditure.

Unit – III Nutrition and Weight Management

- Meaning of weight management Concept of weight management in modern era Factor affecting weight management and values of weight management
- Concept of BMI (Body mass index), Obesity and its hazard, Myth of Spot reduction, Dieting versus exercise for weight control, Common Myths about Weight Loss
- Obesity ï Definition, meaning and types of obesity,
- Health Risks Associated with Obesity, Obesity - Causes and Solutions for Overcoming Obesity.

Unit – IV Steps of planning of Weight Management

- Nutrition ï Daily calorie intake and expenditure, Determination of desirable body weight
- Balanced diet for Indian School Children, Maintaining a Healthy Lifestyle
- Weight management program for sporty child, Role of diet and exercise in weight management, Design diet plan and exercise schedule for weight gain and loss

References:

Bessesen, D. H. (2008). Update on obesity. *J ClinEndocrinolMetab.93*(6), 2027-2034.

Butryn, M.L., Phelan, S., &Hill, J. O.(2007). Consistent self-monitoring of weight: a key component of successful weight loss maintenance.*Obesity(Silver Spring)*. *15*(12), 3091-3096.

Chu, S.Y. & Kim, L. J. (2007). Maternal obesity and risk of stillbirth: a metaanalysis. *Am J ObstetGynecol*, *197*(3), 223-228.

DeMaria, E. J. (*2007).* Bariatric surgery for morbid obesity. *N Engl J Med,356*(21), 2176-2183.

Dixon, J.B., O'Brien, P.E., Playfair, J. (n.d.). Adjustable gastric banding and conventional therapy for type 2 diabetes: a randomized controlled trial. *JAMA. 299*(3), 316-323.

Semester – III

Theory Courses

CC-301 SPORTS TRAINING

Unit – I Introduction to Sports Training

- Meaning and Definition of Sports Training
- Aim and Objective of Sports Training
- Principles of Sports Training
- System of Sports Training ï Basic Performance, Good Performance and High Performance Training

Unit – II Training Components

- Strength ï Mean and Methods of Strength Development
- Speed ï Mean and Methods of Speed Development
- Endurance - Mean and Methods of Endurance Development
- Coordination ï Mean and Methods of coordination Development
- Flexibility ï Mean and Methods of Flexibility Development

Unit – III Training Process

- Training Load- Definition and Types of Training Load
- Principles of Intensity and Volume of stimulus
- Technical Training ï Meaning and Methods of Technique Training
- Tactical Training ï Meaning and Methods of Tactical Training

Unit – IV Training programming and planning

- Periodization ï Meaning and types of Periodization
- Aim and Content of Periods ï Preparatory, Competition, Transitional etc.
- Planning ï Training session
- Talent Identification and Development

Reference:

Dick, W. F. (1980).*Sports training principles.*London: Lepus Books.

Harre, D.(1982).*Principles of sports training.*Berlin: Sporulated.

Jensen, R. C.& Fisher, A.G. (1979). *Scientific basis of athletic conditioning*. Philadelphia: Lea and Fibiger, 2nd Edn.

Matvyew, L.P. (1981).*Fundamental of sports training.* Moscow: Progress Publishers.

Singh, H. (1984).*Sports training, general theory and methods.*Patials: NSNIS.

Uppal, A.K., (1999).*Sports Training.*New Delhi: Friends Publication.

Semester III

Theory Courses

CC-302 COMPUTER APPLICATIONS IN PHYSICAL EDUCATION

Unit – I: Introduction to Computer

- Meaning, need and importance of information and communication technology (ICT). Application of Computers in Physical Education
- Components of computer, input and output device
- Application software used in Physical Education and sports

Unit – II: MS Word

- Introduction to MS Word
- Creating, saving and opening a document
- Formatting Editing features Drawing table ,
- page setup, paragraph alignment, spelling and grammar check printing option, inserting page number, graph, footnote and notes

Unit – III: MS Excel

- Introduction to MS Excel
- Creating, saving and opening spreadsheet
- creating formulas
- Format and editing features adjusting columns width and row height understanding charts.

Unit – IV: MS Power Point

- Introduction to MS Power Point
- Creating, saving and opening a ppt. file
- format and editing features slide show , design , inserting slide number
- picture ,graph ,table
- Preparation of Power point presentations

Referances:

Irtegov, D. (2004). *Operating system fundamentals*. Firewall Media.
Marilyn, M.& Roberta, B.(n.d.).*Computers in your future*. 2nd edition, India: Prentice Hall.
Milke, M.(2007). *Absolute beginner's guide to computer basics*. Pearson Education Asia.
Sinha, P. K. & Sinha, P. (n.d.).*Computer fundamentals*. 4th edition, BPB Publication.

Semester – III

Theory Courses

CC-303 SPORTS PSYCHOLOGY AND SOCIOLOGY

Unit -I: introduction

- Meaning, Importance and scope of Educational and Sports Psychology
- General characteristics of Various Stages of growth and development
- Types and nature of individual differences; Factors responsible -Heredity And environment
- Psycho-sociological aspects of Human behavior in relation to physical education and sports

Unit-II: Sports Psychology

- Nature of learning, theories of learning, Laws of learning,
- Plateau in Learning; & transfer of training
- Meaning and definition of personality, characteristics of personality,
- Dimension of personality, Personality and Sports performance
- Nature of motivation: Factors influencing motivation; Motivation and techniques and its impact on sports performance.
- Mental Preparation Strategies: Attention focus, Self- talk, Relaxation, Imaginary.
- Aggression and Sports, Meaning and nature of anxiety, Kinds of anxiety
- Meaning and nature of stress; Types of stress, Anxiety, Stress, Arousal and their effects on sports performance

Unit-III: Relation between Social Science and Physical Education.

- Orthodoxy, customs, Tradition and Physical Education.
- Festivals and Physical Education.
- Socialization through Physical Education.
- Social Group life, Social conglomeration and Social group, Primary group and Remote group.

Unit-4 Culture : Meaning and Importance.

- Features of culture,
- Importance of culture.
- Effects of culture on people life style.
- Different methods of studying Observation/ Inspection method, Questionnaire method, Interview method

References:

Ball, D. W. & Loy, J. W. (1975).*Sport and social order; Contribution to the sociology of sport.*London: Addison Wesley Publishing Co., Inc.

Blair, J.& Simpson, R.(1962). *Educational psychology*, New York:McMillan Co.

Cratty, B. J.(1968). *Psychology and physical activity*. Eaglewood Cliffs. Prentice Hall.

Kamlesh, M.L. (1998). *Psychology inphysical education and sport*. New Delhi:Metropolitan Book Co.

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Loy, J. W., Kenyon, G. S. & McPherson, B. D. (1981).*Sports culture and society.*Philadelphia: Lea &Febiger.

Mathur, S.S., (1962). *Educational psychology*. Agra.VinodPustakMandir.

Skinnner, C. E., (1984.). *Education psychology*. New Delhi: Prentice Hall of India.

William, F. O.&Meyer, F. N. (1979). A handbook of sociology. New Delhi: Eurasia Publishing House Pvt Ltd.

Semester – III

Theory Courses

EC-301 SPORTS MEDICINE, PHYSIOTHERAPY AND REHANLITATION (ELECTIVE)

Unit-I: - Sports Medicine:

- Sports Medicine: Meaning, Definition, Aims, Objectives, Modern Concepts and Importance.
- Athletes Care and Rehabilitation: Contribution of Physical Education Teachers and Coaches.
- Need and Importance of the study of sports injuries in the field of Physical Education
- Prevention of injuries in sports ï Common sports injuries ï Diagnosis ï
- First Aid - Treatment - Laceration ï Blisters ï Contusion - Strain ï Sprain ï Fracture ï Dislocation and Cramps ï Bandages ï Types of Bandages ï trapping and supports.

Unit-II: Physiotherapy

- Definition ï Guiding principles of physiotherapy, Importance of physiotherapy, Introduction and demonstration of treatments - Electrotherapy ï infrared rays ï Ultraviolet rays ï short wave diathermy ï ultrasonic rays.

Unit-III: Hydrotherapy:

- Introduction and demonstration of treatments of Cry therapy, Thermo therapy, Contrast Bath, Whirlpool Bath ï Steam Bath ï Sauna Bath ï Hot Water Fomentation ï Massage: History of Massage ï Classification of Manipulation (Swedish System) physiological Effect of Massage.

Unit-IV: Therapeutic Exercise:

- Definition and Scope ï Principles of Therapeutic Exercise ï Classification, Effects and uses of Therapeutic exercise ï passive Movements (Relaxed, Forced and passive - stretching) ï active movements (concentric, Eccentric and static) application of the therapeutic exercise: Free Mobility Exercise ï Shoulder, Elbow ï Wrist and Finger Joints ï Hips, Knee, ankle and Foot joints ï Trunk. Head and Neck exercises.

References:

Christine, M. D., (1999). *Physiology of sports and exercise*.USA: Human Kinetics.

Conley, M. (2000). *Bioenergetics of exercise training*. In T.R. Baechle, & R.W. Earle, (Eds.), Essentials of Strength Training and Conditioning (pp. 73-90). Champaign, IL: Human Kinetics.

David, R. M. (2005).*Drugs in sports,* (4th Ed). Routledge Taylor and Francis Group.

Hunter, M. D. (1979). A *dictionary for physical educators.* In H. M. Borrow & R. McGee, (Eds.), A Practical approach to measurement in Physical Education (pp. 573-74). Philadelphia: Lea &Febiger.

Jeyaprakash, C. S., Sports Medicine, J.P. Brothers Pub., New Delhi, 2003.
Khanna, G.L., (1990). *Exercise physiology & sports medicine*. Delhi:Lucky Enterprises.
Mathew, D.K. & Fox, E.L, (1971). *Physiological basis of physical education and athletics*. Philadelphia:W.B. Saunders Co.
Pandey, P.K., (1987). *Outline of sports medicine*, New Delhi: J.P. Brothers Pub.
Williams, J. G. P. (1962). *Sports medicine*. London: Edward Arnold Ltd.

Semester – III

Theory Courses

EC-302 CURRICULUM DESIGN (Elective)

UNIT-I Modern concept of the curriculum

- Need and importance of curriculum, Need and importance of curriculum development, the role of the teacher in curriculum development.
- Factors affecting curriculum - Social factors - Personnel qualifications - Climatic consideration - Equipment and facilities -Time suitability of hours.
- National and Professional policies, Research finding

UNIT-IIBasic Guide line for curriculum construction; contest (selection and expansion).

- Focalization
- Socialization
- Individualization
- Sequence and operation
- Steps in curriculum construction.

UNIT-IIICurriculum-Old and new concepts, Mechanics of curriculum planning.

- Basic principles of curriculum construction.
- Curriculum Design, Meaning, Importance and factors affecting curriculum design.
- Principles of Curriculum design according to the needs of the students and state and national level policies.
- Role of Teachers

UNIT-IV Under-graduate preparation of professional preparation.

- Areas of Health education, Physical education and Recreation.
- Curriculum design-Experience of Education, Field and Laboratory.
- Teaching practice.
- Professional Competencies to be developed-Facilities and special resources for library, laboratory and other facilities.

Reference:

Barrow, H. M. (1983). *Man and movement: principles of physical education*. Philadelphia: Lea and Febiger.

Bucher, C. A. (1986). Foundation of physical education: St. Louis: The C. V. Mosby & Company.

Cassidy, R. (1986). *Curriculum development in physical education*. New York: Harper & Company.

Cowell, C.C. & Hazelton, H.W. (1965). *Curriculum designs in physical education.* Englewood Cliffs: N.J. prentice Hall Inc.

Larson, L.A. (n.d.). *Curriculum foundation in physical education.* Englewood Cliffs: N.J. Prentice Hall Inc.

Underwood, G. L. (1983). *The physical education curriculum in secondary school: planning and implementation.*England: Taylor and Francis Ltd.

Willgoose, C.E. (1979). *Curriculum in physical education*. 3rd Ed. Englewood Cliffs.: N.J. Prentice Hall, Inc.

Semester – IV

Theory Courses

CC-401 MEASUREMENT AND EVALUATION IN PHYSICAL EDUCATION

Unit- IIntroduction to Test & Measurement & Evaluation

- Meaning of Test & Measurement & Evaluation in Physical Education
- Need & Importance of Test & Measurement & Evaluation in Physical Education
- Principles of Evaluation

Unit- IICriteria; ClassificationandAdministration of test

- Criteria of good Test
- Criteria of tests, scientific authenticity (reliability, objectivity, validity and availability of norms)
- Type and classification of Test
- Administration of test, advance preparation ï Duties during testing ï Duties after testing.

Unit- III Physical Fitness Tests

- AAHPER youth fitness test
- National physical Fitness Test
- Indiana Motor Fitness Test
- JCR test
- U.S Army Physical Fitness Test

Unit- IV Sports Skill Tests

- Lockhart and McPherson badminton test
- Johnson basketball test
- McDonald soccer test
- S.A.I volleyball test
- S.A.I Hockey test

References:

Bangsbo, J. (1994). *Fitness training in football: A scientific approach*. Bagsvaerd, Denmark: Ho+Storm.

Barron, H. M., &Mchee, R. (1997). *A practical approach to measurement in physical education*. Philadelphia: Lea and Febiger.

Barron, H.M. &Mchee, R. (1997). A Practical approach to measurement in physical education. Philadelphia: Lea and Febiger.

Kansal, D.K. (1996). *Test and measurement in sports and physical education*. New Delhi: D.V.S. Publications.

Mathews, D.K., (1973). *Measurement in physical education,* Philadelphia: W.B.SoundersCompnay.

Pheasant, S. (1996). *Body space: anthropometry, ergonomics and design of work*. Taylor & Francis, New York.

Phillips, D. A., &Hornak, J. E. (1979). *Measurement and evaluation in physical education*. New York: John Willey and Sons.

Sodhi, H.S., & Sidhu, L.S. (1984). *Physique and selection of sports- a kinanthropometric study*. Patiala: Punjab Publishing House.

Semester – IV
Theory Courses

CC-402 KINESIOLOGY AND BIOMECHANICS

Unit – I Introduction to Kinesiology and Sports Biomechanics

- Meaning and Definition of Kinesiology and Sports Biomechanics
- Importance of Kinesiology and Sports Biomechanics to Physical Education Teacher, Athletes and Sports Coaches.
- Terminology of Fundamental Movements
- Fundamental concepts of following terms ï Axes and Planes, Centre of Gravity, Equilibrium, Line of Gravity

Unit – II Fundamental Concept of Anatomy and Physiology

- Classification of Joints and Muscles
- Types of Muscle Contractions
- Posture ï Meaning, Types and Importance of good posture.
- Fundamental concepts of following terms- Angle of Pull, All or None Law, Reciprocal Innovation

Unit – III Mechanical Concepts

- Force - Meaning, definition, types and its application to sports activities
- Lever - Meaning, definition, types and its application to human body.
- Newtonôs Laws of Motion ï Meaning, definition and its application to sports activities.
- Projectile ï Factors influencing projectile trajectory.

Unit – IV Kinematics and Kinetics of Human Movement

- Linear Kinematics ï Distance and Displacement, speed and velocity, Acceleration
- Angular kinematics ï Angular Distance and Displacement, Angular Speed and velocity, Angular Acceleration.
- Linear Kinetics ï Inertia, Mass, Momentum, Friction.
- Angular Kinetics ï Moment of inertia ,Couple, Stability.

Reference:

Bunn, J. W. (1972).*Scientific principles of coaching.* Englewood Cliffs, N.J.: Prentice Hall Inc.

Hay, J. G. & Reid, J. G.(1982).*The anatomical and mechanical basis of human motion.* Englewood Cliffs, N.J.: prentice Hall Inc.

Hay, J. G. & Reid, J. G.(1988).*Anatomy, mechanics and human motion.* Englewood Cliffs, N.J.: prentice Hall Inc.

Hay, J. G. (1970).*The biomechanics of sports techniques.* Englewood Cliffs, N.J.: Prentice Hall, Inc.

Simonian, C.(1911).*Fundamentalsof sport biomechanics.* Englewood Cliffs, N.J.: Prentice Hall Inc.

Semester – IV
Theory Courses
CC-403 RESEARCH AND STATISTICS IN PHYSICAL EDUCATION

Unit-I Introduction to Research

- Definition of Research
- Need and importance of Research in Physical Education and Sports.
- Scope of Research in Physical Education & Sports.
- Classification of Research
- Research Problem, Meaning of the term, Location and criteria of Selection of Problem, Formulation of a Research Problem, Limitations and Delimitations.

Unit-II Survey of Related Literature

- Need for surveying related literature.
- Literature Sources, Library Reading
- Research Proposal, Meaning and Significance of Research Proposal.
- Preparation of Research proposal / project.
- Research Report: A group project is to be undertaken by a small batch of students under the supervision of a teacher, wherein it is expected to survey school facilities of physical education, health assessment programme evaluation, fitness status of the students, staff and other stakeholders etc. and submit the report to the institution.

Unit-III Basics of Statistical Analysis

- Statistics: Meaning, Definition, Nature and Importance
- Class Intervals: Raw Score, Continuous and Discrete Series, Class Distribution, Construction of Tables
- Graphical Presentation of Class Distribution: Histogram, Frequency Polygon, Frequency Curve. Cumulative Frequency Polygon, Ogive, Pie Diagram

Unit- IVStatistical Models in Physical Education and Sports

- Measures of Central Tendency: Mean, Median and Mode-Meaning, Definition, Importance, Advantages, Disadvantages and Calculation from Group and Ungrouped data
- Measures of Variability: Meaning, importance, computing from group and ungroup data
- Percentiles and Quartiles: Meaning, importance, computing from group and ungroup data

References:

Best, J.W. (1963). *Research in education*. U.S.A.: Prentice Hall.

Bompa, T. O. &Haff, G. G. (2009). *Periodization: theory and methodology of training, 5th ed.* Champaign, IL: Human Kinetics.

Brown, L. E., &Ferrigno, V. A. (2005). Training for speed, agility and quickness, 2nd ed. Champaign, IL: Human Kinetics.

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Carl, E. K., & Daniel, D. A. (1969). Modern principles of athletes training. St. Louis: St. Louisõs Mosby Company.

Clark, H. H., & Clark, D. H. (1975). *Research process in physical education*. Englewood cliffs, New Jersey: Prentice Hall, Inc.

Garrett, H.E. (1981). *Statistics in psychology and education*. New York: VakilsFeffer and Simon Ltd.

Oyster, C. K., Hanten, W. P., & Llorens, L. A. (1987). *Introduction to research: A guide for the health science professional.* Landon: J.B. Lippincott Company.

Thomas, J.R., & Nelson J.K. (2005). *Research method in physical activity*. U.S.A: Champaign, IL: Human Kinetics Books.

Thomas, J.R., Nelson, J.K. & Silverman, S.J. (2011). Research method in physical activity. U.S.A: Champaign, IL: Human Kinetics Books.

Uppal, A. K. (1990). *Physical fitness: how to develop.* New Delhi: Friends Publication.

Verma, J. P. (2000). *A text book on sports statistics.* Gwalior: Venus Publications.

Semester – IV
Theory Courses

EC-401 THEORY OF SPORTS AND GAMES (ELECTIVE)

UNIT-IINTRODUCTION

General Introduction of speciliazed games and sports–

- Athletics,
- Badminton,
- Basketball,
- Cricket,
- Football,
- Gymnastic,
- Hockey,
- Handball,
- Kabaddi,
- Kho-Kho,
- Tennis,
- Volleyball and
- Yoga.

Each game or sports to be dealt under the following heads

- History and development of the Game and Sports
- Ground preparation, dimensions and marking
- Standard equipment and their specifications
- Ethics of sports and sportsmanship

UNIT-II Scientific Principles of coaching: **(particular sports and game specific)**

- Motion ï Types of motion and Displacement, Speed, Velocity, Acceleration, Distance and Newtonôs Law of motions.
- Force ï Friction, Centripetal and Centrifugal force, Principles of force.
- Equilibrium and its types
- Lever and its types
- Sports Training ï Aims, Principles and characteristics.
- Training load ï Components, Principles of load, Over Load (causes and symptoms).

UNIT-III Physical fitness components: (particular sports and game specific)

- Speed and its types
- Strength and its types
- Endurance and its types
- Flexibility and its types
- Coordinative ability and its types

- Training methods: - Development of components of physical fitness and motor fitness through following training methods (continuous method, interval method, circuit method, fartlek /speed play and weight training)

UNIT-IV Conditioning exercises and warming up.

- Concept of Conditioning and warming up.
- Role of weight training in games and sports.
- Teaching of fundamental skill & their mastery (technique, tactic and different phases of skill acquisition).
- Recreational and Lead up games
- Strategy ï Offence and defense, Principles of offence and defense.

References:

Bunn, J. W. (1968). *The art of officiating sports*. Englewood cliffs N.J. Prentice Hall.

Bunn, J. W. (1972). *Scientific principles of coaching.* Englewood cliffs N. J. Prentice Hall.

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Lawther, J.D. (1965). *Psychology of coaching.* New York: Pre. Hall.

Singer, R. N. (1972). *Coaching, athletic & psychology*.New York: M.C. Graw Hill.

Semester – IV

Theory Courses

EC-402 SPORTS MANAGEMENT

Unit-I

- Nature and Concept of Sports Management.
- Progressive concept of Sports management.
- The purpose and scope of Sports Management.
- Essential skills of Sports Management.
- Qualities and competencies required for the Sports Manager.
- Event Management in physical education and sports.

Unit-II

- Meaning and Definition of leadership
- Leadership style and method.
- Elements of leadership.
- Forms of Leadership.
    - Autocratic
    - Laissez-faire
    - Democratic
    - Benevolent Dictator
- Qualities of administrative leader.
- Preparation of administrative leader.
- Leadership and Organizational performance.

Unit-III

- Sports Management in Schools, colleges and Universities.
- Factors affecting planning
- Planning a school or college sports programme.
- Directing of school or college sports programme.
- Controlling a school, college and university sports programme.
    - Developing performance standard
    - Establishing a reporting system
    - Evaluation
    - The reward/punishment system

Unit-IV

- Financial management in Physical Education & sports in schools, Colleges and Universities.
- Budget ï Importance, Criteria of good budget,
- Steps of Budget making
- Principles of budgeting

REFERENCES:

Ashton, D. (1968).*Administration of physical education for women*.New York: The Ronal Press Cl.

Bucher, C.A. *Administration of physical education and athletic programme.* 7th Edition, St. Louis: The C.V. Mosby Co.

Daughtrey, G. & Woods, J.B. (1976). *Physical education and intramural programmes, organisation and administration.* Philadelphia U.S.A. : W.B. Sounders Cp.

Earl, F. Z,& Gary, W. B. (1963).*Management competency development in sports and physical education*. Philadelphia: W. Lea and Febiger.

Part – B
Practical Courses
Semester – I

PC - 101
Track and Field:

Running Event

- Starting techniques: Standing start, Crouch start and its variations, Proper use of blocks.
- Finishing Techniques: Run, Through, Forward lunging, Shoulder Shrug
- Ground Marking, Rules and Officiating
- Hurdles:
    - Fundamental Skills- Starting, Clearance and Landing Techniques.
    - Types of Hurdles
    - Ground Marking and Officiating.

Relays: Fundamental Skills

- Various patterns of Baton Exchange
- Understanding of Relay Zones
- Ground Marking
- Interpretation of Rules and Officiating.

PC 102

Gymnastics: Floor Exercise

- Forward Roll, Backward Roll, Sideward Roll, different kinds of scales, Leg Split, Bridge, Dancing steps, Head stand, Jumps-leap, scissors leap.
- Vaulting Horse
- Approach Run, Take off from the beat board, Cat Vault, Squat Vault.

PC – 102

Swimming: Fundamental Skills

- Entry into the pool.
- Developing water balance and confidence
- Water fear removing drills.
- Floating-Mushroom and Jelly fish etc.
- Gliding with and without kickboard.
- Introduction of various strokes
- Body Position, Leg, Kick, Arm pull, Breathing and Co ordination.
- Start and turns of the concerned strokes.
- Introduction of Various Strokes.
- Water Treading and Simple Jumping.

- Starts and turns of concerned strokes.
- Rules of Competitive swimming-officials and their duties, pool specifications, seeding heats and finals, Rules of the races.

PC – 102

Shooting Fundamental Skills

- Basic stance, grip, Holding rifle/ Pistol, aiming target
- Safety issues related to rifle shooting
- Rules and their interpretations and duties of officials

(Any one out of three)

PC – 103 Indigenous sports:

Kabaddi: Fundamental Skills

- Skills in Raiding-Touching with hand, various kicks, crossing of baulk line, Crossing of Bonus line, luring the opponent to catch, Pursuing.
- Skills of Holding the Raider-Various formations, Catching from particular position, Different catches, Luring the raider to take particular position so as to facilitate catching, catching formations and techniques.
- Additional skills in raiding-Bringing the antis in to particular position, Escaping from various holds, Techniques of escaping from chain formation, Combined formations in offence and defense.
- Ground Marking, Rules and Officiating

PC – 103

Malkhambh and Light Apparatus:

- Lathi-Two counts exercises, Four Count exercises, eight count exercises, sixteen count exercises.
- GhatiLezuim-AathAawaaz, Bethakawaaz, AagePaon, Aagekadam, Do pherawaaz, Chau pherawaaz, Kadamtaal, Pavitra, Uchhakpavitra, Kadampavitra.
- Mass P.T. Exercises-Two count, four count and eight count exercises.
- Hindustani Lezuim-Char Awaaz, EkJagah, AantiLagaav, Pavitra, Do Rukh, Chau Rukh, Chau rukhbethak, Momiya.
- Drill and Marching
- Malkhamb-Salaami, Hold, Saadiudi, Bagaludi, Dashrangudi, Bagliudi, Veludi, Soydoro, Phirki, Padmasana, T.Balance, Pataka, Landing.
- Rope Malkhamb-Salaami, PadmasanaChadh, Katibandh1-2, Sadiadhi, Rikebpakkad, Rikebpagniadhi, Kamaradhi, Nakkikasadhi, Kamaradhi, Nakkikasadhi, Urubandhtedhi, Sadibagli, Do hatibagli, Kamarbandhbagli, nakkikasbagli, Dashrang, Hanuman pakad, Gurupakkad, various padmasana, Landing.

PC - 104

Kho Kho:

- General skills of the game-Running, chasing, Dodging, Faking etc.
- Skills in chasing-Correct Kho, Moving on the lanes, Pursuing the runner, Tapping the inactive runner, Tapping the runner on heels, Tapping on the pole, Diving, Judgement in giving Kho, Rectification of Foul.
- Skills in Running-Zig zag running, Single and double chain, Ring play, Rolling in the sides, Dodging while facing and on the back, fakes on the pole, fake legs, body arm etc, Combination of different skills.
- Ground Marking
- Rules and their interpretations and duties of officials.

PC – 104

Dumbells/ Wands/ Hoop/ Umbrella/ Tipri: Fundamentals skills

- Apparatus/ Light apparatus Grip
- Attention with apparatus/ Light apparatus
- Stand ï at ï ease with apparatus/ ligfht apparatus
- Exrcise with verbal command,drum, whistle and music ï Two count, Four count, Eight count and Sixteen count.
- Standing Exercise
- Jumping Exercise
- Moving Exercise
- Combination of above all

Semester – II

PC – 201

Track and Field

Athletics: Jumping Events

- High Jump (Straddle Roll)
- Approach Run,
- Take off
- Clearance over the bar.
- Landing

PC – 202

Gymnastics:

- Parallel Bar:
- Mount from one bar
- Straddle walking on parallel bars.
- Single and double step walk
- Perfect swing
- Shoulder stand on one bar and roll forward.
- Roll side
- Shoulder stand
- Front on back vault to the side(dismount)
- Horizontal /Single Bar:
- Grip
- Swings
- Fundamental Elements
- Dismount
- Uneven Parallal Bar:
- Grip
- Swings
- Fundamental Elements
- Dismount

PC – 202

Yoga:

- Surya Namaskara,
- Pranayams
- Corrective Asanas
- Kriyas
- Asanas
  - Sitting
  - Standing
  - Laying Prone Position,
  - Laying Spine Position

PC – 202

Swimming:

Introduction of water polo game

- Fundamental skills
- Swimm with the ball
- Passing
- Catching
- Shooting
- Goal keeping
- Rules of the games and responsibility of officials

Introduction of Diving sports.

- Basic Diving Skills from spring boards
- Basic Diving Skills from platform

PC – 202

Aerobics: Introduction of Aerobics

- Rhythmic Aerobics - dance
- Low impact aerobics
- High impact aerobics
- Aerobics kick boxing
- Postures ï Warm up and cool down
- THR Zone ï Being successful in exercise and adaptation to aerobic workout.

PC - 203

Badminton: Fundamental Skills

- Racket parts, Racket grips, Shuttle Grips.
- The basic stances.
- The basic strokes-Serves, Forehand-overhead and underarm, Backhand-overhead and underarm
- Drills and lead up games
- Types of games-Singles, doubles, including mixed doubles.
- Rules and their interpretations and duties of officials.

PC - 203

Table Tennis: Fundamental Skills

- The Grip-The Tennis Grip, Pen Holder Grip.
- Service-Forehand, Backhand, Side Spin, High Toss.
- Strokes-Push, Chop, Drive, Half Volley, Smash, Drop-shot, Balloon, Flick Shit, Loop Drive.
- Stance and Ready position and foot work.
- Rules and their interpretations and duties of officials.

PC – 203

Squash Fundamental Skills

- Service- Under hand and Over hand
- Service Reception
- Shot- Down the line, Cross Court
- Drop
- Half Volley
- Tactics ï Defensive, attacking in game
- Rules and their interpretations and duties of officials.

PC – 203

Tennis: Fundamental Skills**.**

- Grips- Eastern Forehand grip and Backhand grip, Western grip, Continental grip, Chopper grip.
- Stance and Footwork.
- Basic Ground strokes-Forehand drive, Backhand drive.
- Basic service.
- Basic Volley.
- Over-head Volley.
- Chop
- Tactics ï Defensive, attacking in game
- Rules and their interpretations and duties of officials.

Semester – III

PC – 301

Track and fields (Throwing Events)

- Discus Throw, Javelin, Hemmer throw, shot-put
- Basic Skills and techniques of the Throwing events
- Ground Marking / Sector Marking
- Interpretation of Rules and Officiating.
- Grip
- Stance
- Release
- Reserve/ (Follow through action)
- Rules and their interpretations and duties of officials

PC – 302

Boxing: Fundamental Skills

- Player stance
- Stance - Right hand stance, left hand stance.
- Footwork ï Attack, defense.
- Punches ï Jab, cross, hook, upper cut, combinations.
- Defense slip ï bob and weave, parry/block, cover up, clinch, counter attack
- Tactics ï Toe to toe, counter attack, fighting in close, feinting
- Rules and their interpretations and duties of officials.

PC – 302

Martial Arts/Karate: Fundamental Skills

- Player Stances ï walking, hand positions, front-leaning, side-fighting.
- Hand Techniques - Punches (form of a punch, straight punch, and reverse punch), Blocks (eight basic).
- Leg Techniques - Snap kicks, stretching straight leg, thrust kicks, sidekicks, round house.
- Forms - The first cause Katas.
- Self Defense - against punches, grabs and strikes, against basic weapons (knife, club sticks).
- Sparring - One step for middle punch, high punch and groin punch. (Defended by appropriate block from eight basic blocks).
- Rules and their interpretations and duties of officials.

PC – 302

Taekwondo Fundamental Skills

- Player Stances ï walking, extending walking, L stance, cat stance.
- Fundamental Skills ï Sitting stance punch, single punch, double punch, triple punch.
- Punching Skill from sparring position ï front-fist punch, rear fist punch, double punch, and four combination punch.
- Foot Tenchniques (Balgisul) ï standing kick (soseochagi), Front kick (AP chagi), Arc kick (BandalChagi), Side kick, (YeopChagi), Turning kick (DollyoChagi), Back kick (Twit Chagi), Reverse turning kick (BandaeDollyoChagi), Jump kick (TwimyoChagi),
- Poomsae (Forms) ï Jang, Yi Jang, Sam Jang, Sa Jang, O Jang, Yook Jang, Chil Jang, Pal Jang (Fundamental Movement ï eye control, concentration of spirit, speed control, strength control, flexibility, balance, variety in techniques)
- Sparring (Kyorugi) ï One Step Sparring (hand techniques, foot techniques, self defense techniques, combination kicks), Free Sparring.
- Board Breaking (Kyokpa) ï eye control, balance, power control, speed, point of attack.
- Rules and their interpretations and duties of officials.

PC – 302

Judo: Fundamental skills

- Rei (Salutation)-Ritsurei(Salutation in standing position), Zarai (Salutation in the sitting position)
- Kumi kata (Methods of holding judo costume)
- Shisei (Posture in Judo)
- Kuzushi (Act of disturbing the opponent posture)
- Tsukuri and kake (Preparatory action for attack)
- Ukemi (Break Fall)-UrhiroUkemi (Rear break Fall), Yoko Ukemi (Side Break Fall), Mae Ukemi (Front Break Fall), Mae mawariUkemi (Front Rolling break fall)
- Shin Tai (Advance or retreat foot movement)-Suri-ashi (Gliding foot), Twugi-ashi (Following footsteps), Ayumi-ashi (Waling steps.
- Tai Sabaki (Management of the body)
- NageWaze (Throwing techniques)-HizaGuruma (Knee wheel), SesaeTwurikomi-ashi (Drawing ankle throw), De ashihari (Advance foot sweep), O Goshi (Major loinm), SeoiNage (Shoulder throw).
- Katamawaze(Grappling techniques)-Kesagatame (Scaff hold), Kata gatame (Shoulder hold), Kami shihogatama (Locking of upper four quarters), Method of escaping from each hold.

PC – 302

Wrestling: Fundamental Skills

- Take downs, Leg tackles, Arm drag.
- Counters for take downs, Cross face, Whizzer series.
- Escapes from under-sit-out turn in tripped.
- Counters for escapes from under-Basic control back drop, Counters for stand up.
- Pinning combination-Nelson series(Half Nelson, Half Nelson and Bar arm), Leg lift series, Leg cradle series, Reverse double bar arm, chicken wing and half Nelson.
- Escapes from pining: Wing lock series, Dopuble arm lock roll, Cridge.
- Standing Wrestling-Head under arm series, whizzer series
- Referees positions.

PC – 302

Fencing: Fundamental Skill

- Basic Stance - on-guard position (feet and legs)
- Footwork ï advance, retire, lunge, Step-lunge
- Grip ï hold a foil correctly, Etiquette ï salute and handshake to coaches and partners
- Hit a target (glove, mask, person) at riposte distance
- Lunge from an on-guard position.
- Attack - simple attacks from sixte ï direct, disengage, doublé attack, compound attacks high line ï one-two and cut-over disengage, Cut-over attack, Low line attacks
- Semi circular parries ï octave and septime
- Understand the layout of a piste.
- Compound or successive parries.
- Lateral parry and direct riposte
- Fence a bout ï judges etc. salutes and handshakes
- Rules and their interpretations and duties of officials.

PC 303 Team Games

PC 303

Base Ball Fundamental Skills

- Player Stances ï walking, extending walking, L stance, cat stance.
- Grip ï standard grip, choke grip,
- Batting ï swing and bunt.
- Pitching ï

- Baseball : slider, fast pitch, curve ball, drop ball, rise ball, change up, knuckle ball, screw ball,
- Softball: windmill, sling shot,
- starting position: wind up, set.
- Fielding ï
    - Catching: basics to catch fly hits, rolling hits,
    - Throwing: over arm, side arm.

- Base running ï
    - Base running: single, double, triple, home run,
    - Sliding: bent leg slide, hook slide, head first slide.

- Rules and their interpretations and duties of officials.

PC 303

Netball: Fundamental Skills

- Catching: one handed, two handed, with feet grounded, in flight.
- Throwing (different passes and their uses): one handed passes (shoulder, high shoulder, underarm, bounce, lob); two handed passes (push, overhead, bounce).
- Footwork: landing on one foot; landing on two feet; pivot; running pass.
- Shooting: one hand; two hands; forward step shot; backward step shot.
- Techniques of getting free: dodge and sprint; sudden sprint; sprint and stop; sprinting with change of speed.
- Defending: marking the player; marking the ball; blocking; inside the circle; outside the circle (that is, defending the circle edge against the pass in).
- Intercepting: pass; shot.
- The toss-up.
- Role of individual players
- Rules and their interpretations and duties of officials.

PC – 303

Cricket: Fundamental Skills

- Batting-Forward and backward defensive stroke
- Bowling-Simple bowling techniques
- Fielding-Defensive and offensive fielding
- Catching-High catching and Slip catching
- Stopping and throwing techniques
- Wicket keeping techniques

PC 303

Football: Fundamental Skills

- Kicks-Inside kick, Instep kick, Outer instep kick, lofted kick
- Trapping-trapping rolling the ball, trapping bouncing ball with sole
- Dribbling-With instep, inside and outer instep of the foot.
- Heading-From standing, running and jumping.
- Throw in
- Feinting-With the lower limb and upper part of the body.
- Tackling-Simple tackling, Slide tackling.
- Goal Keeping-Collection of balls, Ball clearance-kicking, throwing and deflecting.

PC 303

Hockey: Fundamental Skills

- Player stance & Grip
- Rolling the ball
- Dribbling
- Push
- Stopping
- Hit
- Flick
- Scoop
- Passing ï Forward pass, square pass, triangular pass, diagonal pass, return pass,
- Reverse hit
- Dodging
- Goal keeping ï Hand defence, foot defence
- Positional play in attack and defense.
- Rules and their interpretations and duties of officials.
- Rules and their interpretations and duties of officials.
- Ground Marking.

PC – 303

Softball Fundamental Skills

- Catching: one handed, two handed, with feet grounded, in flight.
- Throwing (different passes and their uses): one handed passes (shoulder, high shoulder, underarm, bounce, lob); two handed passes (push, overhead, bounce).
- Footwork: landing on one foot; landing on two feet; pivot; running pass.
- Shooting: one hand; two hands; forward step shot; backward step shot.

- Techniques of getting free: dodge and sprint; sudden sprint; sprint and stop; sprinting with change of speed.
- Defending: marking the player; marking the ball; blocking; inside the circle; outside the circle (that is, defending the circle edge against the pass in).
- Intercepting: pass; shot.
- The toss-up.
- Role of individual players
- Rules and their interpretations and duties of officials.

PC 303

Volleyball: Fundamental Skills

- Players Stance-Receiving the ball and passing to the team mates,
- The Volley (Over head pass),
- The Dig(Under hand pass).
- Service-Under Arm Service, Side Arm Service, Tennis Service, Round Arm Service.
- Rules and their interpretations and duties of officials.

PC - 303

Hand Ball:

- Fundamental Skills-Catching, Throwing, Ball Control, Goal Throws-Jump Shot, Centre Shot, Dive Shot, Reverse Shot, Dribbling-High and Low, Attack and Counter Attack, Simple Counter Attack, Counter Attack from two wings and centre, Blocking, Goal keeping, Defense.
- Rules and their interpretations and duties of officials.

PC – 303

Basket ball: Fundamental Skills

- Player stance and ball handling
- Passing-Two Hand chest pass, Two hand Bounce Pass, One Hand Base ball pass, Side Arm Pass, Over Head pass, Hook Pass.
- Receiving-Two Hand receiving, One hand receiving, Receiving in stationary position, Receiving while jumping, Receiving while running.
- Dribbling-How to start dribble, How to drop dribble, High dribble, Low dribble, Reverse dribble, Rolling dribble.
- Shooting-Layup shot and its variations, one hand set shot, One hand jump shot, Hook shot, Free throw.
- Rebounding-Defensive rebound, Offensive rebound, Knock out, Rebound Organization.
- Individual Defensive-Guarding the man with the ball and without the ball.
- Pivoting.
- Rules and their interpretations and duties of the officials.

TP – 201 Teaching practices:

10 teaching practice lessons out of which 5 lessons in class-room situation and 5 lessons for out-door activities within premises on the students of B.P.Ed course.

TP – 301 Teaching practices:

10 teaching lesson plans for Racket Sport/ Team Games/ Indigeneous Sports out of which 5 lessons internal and 5 lessons external at school.

TP – 401 **Sports Specialization: Track and field / Gymnastics / Swimming**

(4 internal lesson at prcticing school and 1 final external lesson on the students of practicing school as a sports specialization of any discipline mentioned above.)

TP- 402 **Games Specialization: Kabaddi, Kho-kho, Base ball, cricket, Football, Hockey, Softball Volleyball, Handball, Basketball, Netball, Badminton, Table Tennis, Squash, Tennis**

(4 internal lesson at prcticing school and 1 final external lesson on the students of practicing school as a games specialization of any discipline mentioned above.)

Note: Where ever details of any activities are not mentioned, it is expected to elaborate skills by the competent bodies of local Universities.

Table – 1: Semester wise distribution of hours per week

Semester	***Theory***	***Practicum***	***Teaching practice***	***Total***
I	*16*	*24*	*00*	*40*
II	*16*	*18*	*6*	*40*
III	*16*	*18*	*6*	*40*
IV	*16*	*12*	*12*	*40*
Total	*64*	*72*	*24*	*160*
Minimum of 36 teaching hours per week is required in five or six days in a week				

Table – 2: Number of credits per semester

Semester	***Theory***	***Practicum***	***Teaching practice***	***Total***
I	*16*	*16*	*00*	*32*
II	*16*	*12*	*04*	*32*
III	*16*	*12*	*04*	*32*
IV	*16*	*08*	*08*	*32*
Total	*64*	*48*	*16*	*128*
Minimum of 36 teaching hours per week is required in five or six days in a week				

DEPARTMENT OF BOTANY
B.Sc. (in Faculty of Life Science)
(Based on Choice Based Credit System)
SUBJECT: BOTANY
SYLLABUS
Under NEP-2020

SEMESTER WISE PAPER TITLES WITH DETAILS

Sem.	Course Code	Paper title	CIE	End Semester Examination	Total	Credits	Teaching hours
B. SC. 1ST YEAR OR Certificate Course In Microbial Technology & Applied Botany							
I	**BOTB101T**	Microbiology & Plant Pathology	25	75	100	4	60
	BOTB102P	Techniques in Microbiology &Plant Pathology	25	75	100	2	60
II	**BOTB201T**	Archegoniates &Plant Architecture	25	75	100	4	60
	BOTB202P	Land Plants Architecture	25	75	100	2	60
B. SC. 2ND YEAR OR **Diploma in Plant Identification, Utilization & Ethnomedicine**							
III	**BOTB301T**	Flowering Plants Identification &AestheticCharacteristics	25	75	100	4	60
	BOTB302 P	Plant Identification technology	25	75	100	2	60
IV	**BOTB401T**	Economic Botany, Ethnomedicine & Phytochemistry	25	75	100	4	60
	BOTB402 P	Commercial Botany & Phytochemical Analysis	25 25	75 75	100 100	2	60
B. SC. 3RD YEAR OR **Degree in Bachelor of Science (in Faculty of Life Science)**							
V	**BOTB501 T**	Plant Physiology, Metabolism & Biochemistry	25	75	100	4	60
	BOTB502T	Molecular Biology & Bioinformatics	25	75	100	4	60
	BOTB503P	Experiments in physiology, Biochemistry & molecular biology	25	75	100	2	60
VI	**BOTB601T**	Cytogenetics, Plant Breeding & Nanotechnology	25	75	100	4	60
	BOTB602T	Ecology & Environment	25	75	100	4	60
	BOTB603P	Cytogenetics, Conservation & Environment management	25	75	100	2	60

Subject Prerequisites:

1. To study Botany, a student must have had the subject Biology/Biotechnology learnt at 10+2 level.
2. Keen interest in plants and plant-related research, Potential in mathematics, biology and chemistry
3. Skills and aptitude for scientific study and research
4. Creativity and good comprehension while working on scientific procedures and research
5. Computer aptitude.

COURSE INTRODUCTION

The new curriculum of B.Sc. in Science (Botany) offers essential knowledge and technical skills to studyplants in a holistic manner. Students would be trained in all areas of plant biology using a unique combination of core, elective and vocational papers with significant inter-disciplinary components. Students would be exposed to cutting-edge technologies that are currently used in the study of plant lifeforms, their evolution and interactions with other organisms within the ecosystem. Students would also become aware of the social and environmental significance of plants and their relevance to the national economy.

B.Sc.Programme covers academic activities within the classroom sessions along with practical concepts at laboratory sessions. Infield, outstation activities and projects are also required to be organizedfor real-life experience and learning.

Candidates who have curiosity in plants kingdom, ecosystem, love exploring exotic places and wish to work as researchers or professions like Botanist, Conservationist, Ecologist, etc. can choose B.Sc. course with Botany.

Programme outcomes (POs):

Transformed curriculum shall develop educated outcome-oriented candidature, fostered with discovery- learning, equipped with practice & skills to deal practical problems and versed with recent pedagogical trends in education including e-learning, flipped class and hybrid learning to develop into responsible citizen for nation-building and transforming the country towards the future with their knowledge gained in the field of plant science.

PO 1	CBCS syllabus with a combination of general and specialized education shall introduce the concepts of breadth and depth in learning
PO2	Shall produce competent plant biologists who can employ and implement their gainedknowledge in basic and applied aspects that will profoundly influence the prevailing paradigm of agriculture, industry, healthcare and environment to provide sustainable development.
PO 3	Will increase the ability of critical thinking, development of scientific attitude, handling of problems and generating solutions, improve practical skills, enhance communication skill, social interaction, increase awareness in judicious use of plant resources by recognizing the ethical value system.
PO 4	The training provided to the students will make them competent enough for doing jobs in Govt. and private sectors of academia, research and industry along with graduate preparation for national as well as international competitive examinations, especially UGC-CSIR NET, UPSC Civil Services Examination, IFS, NSC, FCI, BSI, FRI etc.
PO 5	Certificate and diploma courses are framed to generate self- entrepreneurship and self-employability, if multi exit option is opted.
PO 6	Lifelong learning be achieved by drawing attention to the vast world of knowledge of plants and their domestication.

Programme specific outcomes (PSOs):
B.Sc. I Year / Certificate course in Microbial Technology & Classical Botany

This Programme imparts knowledge on various fields of plant biology through teaching, interactions andpractical classes. It shall maintain a balance between the traditional botany and modern science for shifting it towards the frontier areas of plant sciences with applied approach. This syllabus has been drafted to enable the learners to prepare them for self-entrepreneurship and employment in various fields includingacademics as well as competitive exams. Students would gain wide knowledge in following aspects:

1. Diversity of plants and microbes, their habitat, morphology, architecture and reproduction.

2. Plant disease causing microbes, symptoms & control.

3. Economic value of plants and their use in Human Welfare.

Programme specific outcomes (PSOs):
B.Sc. II Year/ (Diploma in Plant Identification, Utilization & Ethnomedicine)

This course provides a broad understanding of identifying, growing and using plants. This course is primarily aimed to introduce people to the richness of plant diversity found in surrounding areas. Lecture sessions are designed to cover fundamental topics concerning classification of plants and their utilization required for understanding the flora and vegetation. Practical sessions are organized following theory for easy understanding of the various parts of the plants, structural organization of floral parts and diversity therein. Participants are taken to different locations covering a variety of habitats and forest types to acquaint them with the native flora. in the long run, will contribute towards building momentum for people's participation in environmental conservation without compromising on academic rigor and ourrich wealth of knowledge inherited over generations.

1. The course will cover conventional topics in Field Botany like Evolutionary History & Diversity ofplants, Complete Morphology, Nomenclature of plants, Systems of Classification, Keys to important Families of Flowering Plants, Field Data Collection & Herbarium Techniques.

2. The course is designed to become a commercial crop grower, florist, protected cultivator, greenbelt plant advisor to industries, pharmacologist & taxonomist.

Programme specific outcomes (PSOs):
B.Sc. III Year / Bachelor of Science

The learning outcomes of a three years graduation course are aligned with programme learning outcomes but these are specific to-specific courses offered in a program. The core courses shall be the backbone of this framework whereas discipline electives, generic electives and skill enhancement courses would add academic excellence in the subject together with a multi-dimensional and multidisciplinary approach.

1. Understanding of plant classification systematics, evolution, ecology, developmental biology, physiology, biochemistry, plant interactions with microbes and insects, morphology, anatomy, reproduction, genetics and molecular biology of various life-forms.
2. This course is suitable to produce expertise in conservation biology like ex-situ conservation,response to habitat change, genotype characterization and reproductive biology.
3. Understanding of various analytical techniques of plant sciences, use of plants as industrial resources or as a human livelihood support system and is well versed with the use of transgenic technologies for basic and applied research in plants.
4. Understanding of various life forms of plants, morphology, anatomy, reproduction, genetics, microbiology, molecular biology, recombinant DNA technology, transgenic technology and use of bioinformatics tools and databases and the application of statistics to biological data.
5. Entrepreneurship Skill Development, Understand the issues of environmental contexts and sustainabledevelopment, Inculcation of human values,

6. Strengthen mathematical and computational skills. Enable students to use ICT & AI effectively. **7.** Develop good skills in the laboratory such as observation and evaluation by the use of modern tools and technology.	
PSO 1	Understanding the nature and basic concepts of all the plant groups, their metabolism, components at the molecular level, biochemistry, taxonomy and ecology. The course will make them aware of natural resources and the environment and the importanceof conserving it. Hands-on training in various fields will develop practical skills, handling equipment and laboratory use along with collection and interpretation of biological materials and data. Knowledge gained through theoretical and lab-based experiments will generate technical personnel in various priority areas such as genetics, cell and molecular biology, plantsystematics and biotechnology.
PSO 2	Botanists are able to contribute to all these fields and therefore, are mainly employed with educational institutions, government or public sectors or companies in industries, such as agriculture or forestry, oil, chemical, biotechnology, geological survey, environmental protection, drugs, genetic research, plant resources laboratories, plant health inspectionservices, lumber and paper, food, fermentation, nursery, fruit and so on. Jobs available as a botanist: •Microbiologist, plant pathologist, Taxonomist • Plant Physiologist • Plant Biochemist • Researcher • Mycologist • Ecologist • Weed Scientist • Palaeobotanist • Conservationist • Fruit Grower • Morphologist • Cytologist • Ethnobotanist • Plant geneticistsetc.
PSO 3	Inculcate strong fundamentals on modern and classical aspects of Botany, understand knowledge of Botany is an essential pre-requisite for the pursuit of many applied sciences. Itwill facilitate students for taking up and shaping a successful career in Botany and allied sciences.
PSO 4	Introduction of research project will inculcate research aptitude and passion for highereducation and scientific research.

Programme: Certificate	Year: I	Semester: I/Paper-I
Subject: Botany		
Course Code: BOTB101T	**Course Title: Microbiology & Plant Pathology**	

Course outcomes: After the completion of the course the students will be able to:

1. Develop understanding about the classification and diversity of different microbes including viruses, Algae, Fungi & Lichens &their economic importance.
2. Develop conceptual skill about identifying microbes, pathogens, biofertilizers & lichens.
3. Gain knowledge about developing commercial enterprise of microbial products.
4. Learn host –pathogen relationship and disease management.
5. Learn Presentation skills (oral & writing) in life sciences by usage of computer & multimedia.
6. Gain Knowledge about uses of microbes in various fields.
7. Understand the structure and reproduction of certain selected bacteria algae, fungi and lichens
8. Gain Knowledge about the economic values of this lower group of plant community.

Credits: **4**	**Core Compulsory**
Max. Marks **CIE: 25**	Min. Passing Marks **CIE:09**
Max. Marks **End Semester Examination: 75**	Min. Passing Marks **End Semester Examination: 26**
Total Max. Marks: 100	**Total Min. Passing Marks: 35**

Total No. of Lectures-Tutorials-Practical (in hours per week): **4-0-0**

Unit	Topic	No. of Lectures (60 hrs)
I	**A. Introduction to Indian ancient, Vedic and heritage Botany and contribution of Indian Botanists, in context with the holistic development of modern science and technology** **B. Microbial Techniques & instrumentation** Microscopy – Light, phase contrast, electron, scanning and transmission electron microscopy, staining techniques for light microscopy, sample preparation for electron microscopy. Common equipment of microbiology lab and principle of their working – autoclave, oven, laminar air flow, centrifuge. Colorimetry and spectrophotometry, immobilization methods, fermentation and fermenters.	**8**
II	**Microbial world** Cell structure of Eukaryotic and prokaryotic cells, Gram positive and Gram-negative bacteria, Structure of a bacteria; Bacterial Chemotaxis and Quorum sensing, Bacterial Growth curve, factors affecting growth of microbes; measurement of growth; Batch culture, fed batch culture and continuous culture; Synchronous growth of microbes; Sporulation and reproduction and recombination in bacteria. Viruses, general characteristics, viral culture, Structure of viruses, Bacteriophages, Structure of T4 &, λ-phage; Lytic and Lysogenic cycles, viroid, Prions & mycoplasma & phytoplasma, Actinomycetes & plasmids and their economic uses.	**8**
III	**Phycology** Range of thallus organization in Algae, Pigments, Reserve food –Reproduction - Classification and life cycle of – *Nostoc, Chlorella, Volvox, Hydrodictyon, Oedogonium, Chara; Sargassum, Ectocarpus, Polysiphonia.* Economic importance of algae - Role of algae in soil fertility- biofertilizer – Nitrogen fixation- Symbiosis; Commercialproducts of algae –biofuel, Agar.	**7**
IV	**Mycology** General characteristics, nutrition, life cycle, Economic importance of Fungi, Classification upto class. Distinguishing characters of Myxomycota: General characters of Mastigomycotina, Zygomycota: *Rhizopus*, **Ascomycota:** *Saccharomyces, Penicillium, Peziza.* **Basidiomycotina:** *Ustilago, Puccinia, Agaricus;* **Deuteromycotina:** *Fusarium, Alternaria*. Heterothallism, Physiological specialization, Heterokaryosis & Parasexuality.	**7**
V	**Mushroom Cultivation, Lichenology & Mycorrhiza** Mushroom cultivation. General account of lichens, reproduction and significance; *Mycorrhiza: ectomycorrhiza* and *endomycorrhiza* and theirsignificance.	**7**

VI	**Plant Pathology** Disease concept, Symptoms, Etiology & causal complex, Primary and secondary inoculum, Infection, Pathogenicity and pathogenesis, Koch's Postulates. Mechanism of infection (Brief idea about Pre-penetration, Penetration and Post- penetration), Disease cycle (monocyclic, polycyclic and polyetic). Defense mechanism with special reference to Phytoalexin, Resistance- Systemic acquired and Induced systemic fungicides- Bordeaux mixture, Lime Sulphur, Tobacco decoction, Neem cake & oil	**7**
VII	**Diseases and Control** Symptoms, Causal organism, Disease cycle and Control measures of – Early & Late Blight of Potato, False Smut of Rice/ Brown spot of rice, Black Stem Rust of Wheat, *Alternaria* spot' and 'White rust of Crucifers, Red Rot of Sugarcane, Wilting of Arhar, Mosaic diseases on tobacco and cucumber, yellow vein mosaic of bhindi; Citrus Canker, Little leaf of brinjal; Damping off of seedlings, Disease management: Quarantine, Chemical, Biological, Integrated pest disease management	**8**
VIII	**Applied Microbiology** Food fermentations and food produced by microbes, amino acids, Production of antibiotics, enzymes, vitamins, alcoholic beverages, organic acid & genetic recombinant vaccines. Mass production of bacterial biofertilizers, blue green algae, *Azolla* and *mycorrhiza*. Plant growth promoting rhizobacteria & biopesticides— *Trichoderma sp.* and *Pseudomonas*, Single cell proteins, Organic farming inputs, Microbiology of water, Bioploymers, Bioindicators, biosensors, Bioremediation, Production of biofuels, biodegradation of pollutants and biodeterioration of materials & Cultural Property.	**8**

Suggested Readings:

1. Kumar, H.D. (1999). Introductory Phycology. Affiliated East-West. Press Pvt. Ltd. Delhi. 2nd edition.
2. Tortora, G.J., Funke, B.R., Case, C.L. (2010). Microbiology: An Introduction, Pearson Benjamin Cummings, U.S.A. 10th edition.
3. Sethi, I.K. and Walia, S.K. (2011). Text book of Fungi & Their Allies, MacMillan Publishers Pvt. Ltd., Delhi.
4. Aggarwal, S. K. 2009. Foundation Course in Biology, A one books Pvt. Ltd., New Delhi.
5. Aneja, K. R. 1993. Experiments in Microbiology, Pathology and Tissue Culture, Vishwa Prakashan, NewDelhi.
6. Annie Ragland, 2012. Algae and Bryophytes, Saras Publication, Kanyakumari, India.
7. Basu, A. N. 1993. Essentials of Plant Viruses, Vectors and Plant diseases, New Age International, New Delhi.
8. Chopra. G. L. 1984. A text book of Algae, Rastogi publications, Meerut,India.
9. Desikachari, T. V. 1959. Cyanophyta, ICAR, New Delhi.
10. Dubey, R. C. and Maheshwari. D.K. 2012. Practical Microbiology, S. Chand & Company, Pvt. Ltd., NewDelhi.
11. Fritsch, R. E. 1977. Structure and Reproduction of Algae, Cambridge University Press, London.
12. Kodo, C.I. and Agarwal, H.O.1972. Principles and techniques in Plant Virology, Van Nostrand, Reinhold Company, New York.
13. Agrios, G.N. (1997). Plant Pathology, 4th edition. Cambridge, U.K.: Academic Press.
14. Sharma, P.D. (2011). Plant Pathology. Meerut, U.P.: Rastogi Publication.
15. Webster, J., Weber, R. (2007). Introduction to Fungi, 3rd edition. Cambridge, U.K.: Cambridge University Press..
16. Pandey B.P. 2001. College Botany Volume 1, S Chand & Company Pvt.Ltd, New Delhi.
17. Pandey. B.P. 2014 Modern Practical Botany, (Vol-I) S. Chand and Company Pvt. Ltd., New Delhi.
18. Pelzar, 1963. Microbiology, Tata Mc Graw Hill, New Delhi
19. Rangaswamy, G. 2009, Disease of Crop Plants in India, Prientice Hall of India, New Delhi.
20. Sambamurty. A.V.S.S. 2006, A Text book of Algae, I. K. International Publishing House, Pvt. Ltd., New Delhi.
21. Sharma, P. D. 2012, Microbiology and Plant Pathology, Rastogi Publication Pvt Ltd., Meerut, India.
22. Singh, R. P. 2007. Microbial Taxonomy and Culture Techniques, Kalyani Publication, New Delhi.
23. Smith. G. M. 1996. Cryptogamic Botany Volume I, Tata Mc Graw Hill, New Delhi.
24. Sundar Rajan. S. 2010.College Botany Volume I, Himalaya Publications, Mumbai.
25. Vashishta, B.R. Sinha, A.K. and Singh, V. P. 1991. Algae, S. Chand and Company, Pvt. Ltd., New Delhi

Suggested Continuous Evaluation Methods:

Total marks: 25

One Test/Assignments (hand written or typed 500 -1500 words)/Quizzes/ Presentation etc. (as decided by the teacher) carrying Maximum Marks 20 and a Viva-Voce/Class interaction of 5 marks.

Qualification: To study this course, a student must have qualified 10+2 with Biology/ NSQF level 3 from Sector Skill Councils / Diploma holder from ITI in (Biology/ Agriculture/ Biotech/ Forestry/ Microbiology/Gardening /biomedical Science.
Facilities: Smart and Interactive Class
Other Requisites: Video collection, Books, CDs, Access to On-line resources, Display Charts

Suggested equivalent online courses: https://indianculture.gov.in/rarebooks/economic-botany-india https://community.plantae.org/tags/mooc

futurelearn.com/courses/teaching-biology-inspiring-students-with-plants-in-science https://www.coursera.org/courses?query=plants http://egyankosh.ac.in/handle/123456789/53530 https://www.classcentral.com/tag/microbiology https://www.edx.org/learn/microbiology

https://www.mooc-list.com/tags/microbiology https://www.udemy.com/topic/microbiology/ https://ucmp.berkeley.edu/bacteria/bacteria.html https://www.livescience.com/53272-what-is-a-virus.html https://gclambathach.in/lms/Economic%20importance%20of%20Algae.pdf https://www.slideshare.net/sardar1109/algae-notes-1 https://www.onlinebiologynotes.com/algae-general-characteristics-classification/ https://www.sciencedirect.com/topics/immunology-and-microbiology/fungus https://ucmp.berkeley.edu/fungi/fungi.html

https://agrimoon.com/wp-content/uploads/Mashroom-culture.pdf http://ecoursesonline.iasri.res.in/mod/page/view.php?id=11293 http://www.hillagric.ac.in/edu/coa/ppath/lect/plpath111/Lect.%201%20%20Introduction-Pl%20Path%20111.pdf http://www.jnkvv.org/PDF/11042020102651plant_pathology.pdf https://www.apsnet.org/edcenter/disimpactmngmnt/topc/EpidemiologyTemporal/Pages/ManagementStrategies.aspx https://learn.saylor.org/course/view.php?id=23&sectionid=6821

https://www.sciencedirect.com/topics/earth-and-planetary-sciences/microscopy http://physics.fe.uni-lj.si/students/predavanja/Microscopy_Kulkarni.pdf https://lipidnanostructuresgroup.weebly.com/ https://zoology4civilservices.wordpress.com/2016/06/18/65/ https://microbenotes.com/laminar-flow-hood/

Programme: Certificate	Year: I	Semester: I/Paper-II
Subject: Botany		
Course Code: BOTB102P	**Course Title: Techniques in Microbiology &Plant Pathology**	

Course outcomes: After the completion of the course the students will be able:

1. Understand the instruments, techniques, lab etiquettes and good lab practices for working in a microbiologylaboratory.
2. Develop skills for identifying microbes and using them for Industrial, Agriculture and Environment purposes.
3. Practical skills in the field and laboratory experiments in Microbiology & Pathology.
4. learn to identify Algae, Lichens and plant pathogens along with their Symbiotic and Parasitic associations.
5. Can initiate his own Plant & Seed Diagnostic Clinic
6. Can start own enterprise on microbial products

Credits:**2**	**Core Compulsory**
Max. Marks **CIE: 25** Max. Marks **End Semester Examination:75** **Total Max. Marks: 100**	Min. Passing Marks **CIE:09** Min. Passing Marks **End Semester Examination: 26** **Total Min. Passing Marks: 35**

Total No. of Lectures-Tutorials-Practical (in hours per week): **0-0-2**

Unit	Suggested Lab / Virtual Experiments (Minimum Any Three from Each Unit Depending on Facilities)	No. of Lectures (60 Hrs)
1.	**INSTRUMENTS & TECHNIQUES** 1. Laboratory safety and good laboratory practices 2. Principles and application of Laboratory instruments-microscope, incubator,autoclave, centrifuge, LAF, filtration unit, shaker, pH meter. 3. Buffer preparation & titration 3. Cleaning and Sterilization of glasswares 4. Preparation of media- Nutrient Agar and Broth 5. Inoculation and culturing of bacteria in Nutrient agar and nutrient broth 6. Preparation of agar slant, stab, agar plate 7. Phenol Coefficient method to test the efficacy of disinfectants	**7**
II	**BACTERIAL IDENTIFICATION** 1. Isolation of bacteria. 2. Identification of bacteria. 3. Staining techniques: Gram's, Negative, Endospore, Capsule and Cell Wall. 4. Cultural characteristics of bacteria on NA. 5. Pure culture techniques (Types of streaking). 6. Biochemical characterization: IMViC, Carbohydrate fermentation test, Mannitol motility test, Gelatin liquefaction test, Urease test,Nitrate reduction test, Catalase test, Oxidase test, Starch hydrolysis, Casein hydrolysis.	**8**
III	**MYCOLOGICAL STUDY:** 1. Isolation of different fungi: Saprophytic, Coprophilous, Keratinophilic. *2.* Identification of fungi by lactophenol cotton blue method. *Rhizopus, Saccharomyces,Penicillium, Peziza, Ustilago, Puccinia; Fusarium, Curvularia, Alternaria.* 3. *Agaricus*: Specimens of button stage and ful grown mushroom; Sectioning of gills of *Agaricus*. 4. Lichens: crustose, foliose and fruticose specimens.	**8**
IV	**PHYCOLOGY:** 1. Type study of algae and Cyanobacteria –*Spirullina, Nostoc.* Chlorophyceae - *Chlorella, Volvox, Oedogonium, Cladophora,*and *Chara;* Xanthophyceae – *Vaucheria;* Bacillariophyceae – *Pinnularia* Phaeophyceae – *Sargassum* *R*hodophyceae - *Polysiphonia*	**7**

V	**EXPERIMENTAL PLANT PATHOLOGY** 1. Preparation of fungal media (PDA) &Sterilization process. 2. Isolation of pathogen from diseased leaf. Identification: Pathological specimens of Brown spot of rice, Bacterial blight of rice, Loose smut of wheat, Stem rot of mustard, Late blight of potato; Slides of uredial, telial, pycnial & aecial stages of *Puccinia*, Few viral and bacterial plant diseases.	**8**
VI	**PRACTICALS IN APPLIED MICROBIOLOGY-1** 1. Isolation of nitrogen fixing bacteria from root nodules of legumes. 2. Enumeration of rhizosphere to non rhizosphere population of bacteria. 3. Isolation of antagonistic Pseudomonas from soil. 4. Microscopic observations of root colonization by VAM fungi. 5. Isolation of Azospirillum sp. from the roots of grasses. 6. Isolation of phyllosphere microflora. 7. Isolation of P solubilizing microorganisms.	**8**
VII	**PRACTICALS IN APPLIED MICROBIOLOGY-2** 1. Wine production. 2. Isolation of lactic acid bacteria from curd. 3. Isolation of lipolytic organisms from butter or cheese. 4. Immobilized bacterial cells for production of hydrolytic enzymes. 5. Enzyme production and assay – cellulase, protease and amylase. 6. Immobilization of yeast. 7. Isolation of cellulolytic and anaerobic sulphate reducing bacteria. 8. Isolation and characterization of acidophilic, alkalophilic and halophilic bacteria.	**8**
VIII	1. Cultivation of Spirulina, & Chlorella in lab for biofuel 2. Visit to NBAIM, Mau, Varanasi (Kashi)/ IMTECH (Institute of Microbial Technology),Chandigarh for viewing Culture Repository 3. Visit to biofertilizers and biopesticides unit to understand about the Unit operation procedures 4. Mushroom cultivation for Protein 5. Alcohol production. from Sugarcane Juice.	**6**

Suggested Readings:

1. Aneja, K. R. 1993. Experiments in Microbiology, Pathology and Tissue Culture, Vishwa Prakashan, New Delhi.
2. Dubey, R. C. and Maheshwari. D.K. 2012. Practical Microbiology, S. Chand & Company, Pvt. Ltd., New Delhi.
3. Kodo, C.I. and Agarwal, H.O.1972. Principles and techniques in Plant Virology, Van Nostrand, Reinhold Company,New York.
4. Madhavee Latha, P. 2012, A Textbook of Immunology, S. Chand & Company Pvt. Ltd., New Delhi.
5. Pandey. B.P. 2014 Modern Practical Botany, (Vol-I) S. Chand and Company Pvt. Ltd., New Delhi.
6. Sambamurty. A.V.S.S. 2006, A Textbook of Algae, I. K. International Publishing House, Pvt. Ltd.,
7. Singh, R. P. 2007. Microbial Taxonomy and Culture Techniques, Kalyani Publication, New Delhi.
8. https://agrimoon.com/wp-content/uploads/Mashroom-culture.pdf
9. http://nhb.gov.in/pdf/Cultivation.pdf
10. https://www.k-state.edu/fungi/Greeting/Publications_files/2006%20Handbook.pdf
11. 11. Sen, Surjit,Acharya, Krishnendu, Rai, Manjula 2019 IBSN - 978-93-88347-23-5 - Biofertilizers and Biopesticides .Technoworld, Kolkata
12. http://www.kvkkendrapara.org/pdf/Bio%20Fertilizer%20Production%20and%20marketing.pdf
13. http://www.gbv.de/dms/tib-ub-hannover/751302945.pdf
14. Hochman,Gal,Zilberman,David 2014 IBSN-1461493285- Algae Farming and Its Bio-Products Springer
18. Gokare A. Ravishankar , Ranga Rao Ambati 2019 Handbook of Algal Technologies and Phytochemicals Volume II:Phycoremediation, Biofuels and Global Biomass Production Print ISBN: 9780367178192
19. Amos Richmond Ph.D., Prof. Emeritus, Qiang Hu Ph.D 2013. Handbook of Microalgal Culture: Applied Phycologyand Biotechnology, Second Edition Print ISBN:9780470673898

Suggested Continuous Internal Evaluation(CIE)methods

Total marks: 25

One Practical Tests/Record/Chart/Model carrying Maximum Marks 20 and a Viva-Voce/Practical Class Interaction as decided by the concerned teacher/HOD) of 5 marks.

Course prerequisites:

Qualification: To study this course, a student must have qualified 10+2 with Biology/ NSQF level 3 from Sector Skill Councils /Diploma holder from ITI in (Biology/ Agriculture/ Biotech/ Microbiology/biomedical Science.

Facilities: Smart and Interactive Class

Other Requisites: Video collection, Books, CDs, Access to On-line resources, Display Charts

Lab Requisites: Microscopes, Stains, Dissection box, Haemocytometer, Specimens, Permanent slides, Autoclave, incubator,

Oven, laminar flow cabinet, balances, Fermenter, Anaerobic jar and Spectrophotometer.

Suggested equivalent online courses:

https://community.plantae.org/tags/mooc

futurelearn.com/courses/teaching-biology-inspiring-students-with-plants-in-science

https://microbiologysociety.org/publication/education-outreach-resources/basic-practical-microbiology-a-manual.html

https://microbiologyonline.org/file/7926d7789d8a2f7b2075109f68c3175e.pdf

http://allaboutalgae.com/benefits/ https://repository.cimmyt.org/xmlui/bitstream/handle/10883/3219/64331.pdf

https://www.mooc-list.com/tags/microbiology

http://www.agrifs.ir/sites/default/files/A%20text%20book%20of%20practical%20botany%201%20%7BAshok%20Bendre%7D%20%5B8 171339239%5D%20%281984%29.pdf

https://www.coursera.org/courses?query=plantshttp://egyankosh.ac.in/handle/123456789/53530

https://www.classcentral.com/tag/microbiology https://www.edx.org/learn/microbiology https://www.mooc-list.com/tags/microbiology https://www.udemy.com/topic/microbiology/

Programme : Certificate	Year: I	Semester: II Paper-I
Subject: Botany		
Course Code: BOTB201T	**Course Title: Archegoniates and Plant Architecture**	

Course outcomes:

After the completion of the course the students will be able to:

1. Develop critical understanding on morphology, anatomy and reproduction of Bryophytes, Pteridophytes and Gymnosperms
2. Understanding of plant evolution and their transition to land habitat.
3. Understand morphology, anatomy, reproduction and developmental changes therein through typological study and create a knowledge base in understanding the basis of plant diversity, economic values & taxonomy of plants
4. Understand the details of external and internal structures of flowering plants.

Credits: **4**	**Core Compulsory**
Max. Marks **CIE: 25** Max. Marks **End Semester Examination:75** **Total Max. Marks: 100**	Min.Passing Marks **CIE:09** Min. Passing Marks **End Semester Examination: 26** **Total Min. Passing Marks: 35**

Total No. of Lectures-Tutorials-Practical (in hours per week): **4-0-0**

Unit	Topic	Lectures (60 Hrs)
I	**Introduction to Archegoniates & Bryophytes** Unique features of archegoniates, Bryophytes: General characteristics, adaptations to land habit, Range of thallus organization. Classification (up to family), morphology, anatomy and reproduction of *Riccia*, *Marchantia* , *Anthoceros and Sphagnum*. (Developmental details not tobe included). economic importance of bryophytes .	**7**
II	**Pteridophytes** General characteristics, Early land plants (*Rhynia*). Classification (up to family) with examples, Heterospory and seed habit, stelar evolution, economic importance of Pteridophytes.	**8**
III	**Gymnosperms** Classification and distribution of gymnosperms; Salient features of Cycadales, Ginkgoales, Coniferales and Gnetales, their examples, structure and reproduction; economic importance	**8**
IV	**Palaeobotany** General account of Cycadofilicales, Bennettitales and Cordaitales; Geological time scale; Brief account of process of fossilization & types of fossils and study techniques ; Contributionof Birbal Sahni	**8**
V	**Angiosperm Morphology (Stem, Roots, Leaves & Flowers, Inflorescence)** Morphology and modifications of roots; Stem, leaf and bud. Types of inflorescences; flowers, flower parts, fruits and types of placentation; Definition and types of seeds.	**7**
VI	**Plant Anatomy:** Meristematic and permanent tissues, Organs (root, stem and leaf). Apical meristems & theories on apical organization - Apical cell theory, Histogen theory, Tunica - Corpus theory. Secondary growth - Root and stem- cambium (structure and function) annular rings, Anomalous secondary growth - *Bignonia, Boerhaavia, Dracaena,Nyctanthes*	**7**
VII	**Reproductive Botany** Plant Embryology, Structure of microsporangium, microsporogenesis, , Structure of megasporangium and its types, megasporogenesis, Structure and types of female gametophyte, types of pollination, Methods of pollination, Germination of pollen grain, structure of male gametophyte, Fertilization, structure of dicot and monocot embryo, Endosperm, Double fertilization, Apomixis and polyembryony.	**8**
VIII	**Palynology:** Pollen structure, pollen morphology, pollen allergy , Applied Palynology: Basic concepts, Palaeopalynology, Aeropalynology, Forensic palynology, Role in taxonomicevidences.	**7**

Suggested Readings:

1. Gangulee H. S. and K. Kar 1992. College Botany Vol. I and II. (New Central Book Agency)
2. Bhatnagar, S.P. and Moitra, A. (1996). Gymnosperms. New Age International (P) Ltd Publishers, New Delhi, India.
3. Parihar, N.S. (1991). An introduction to Embryophyta. Vol. I. Bryophyta. Central Book Depot, Allahabad.
4. Rashid A (1999) An Introduction to Pteridophyta, Vikas Publishing House Pvt. Ltd. New Delhi.
5. Sharma OP (1990) Textbook of Pteridophyta. MacMillan India Ltd. Delhi.
6. Vashishtha BR, Sinha AK and Kumar A (2010) Botany for Degree Students – Pteridophyta, S. Chand and Company,
7. Vashishtha BR, Sinha AK and Kumar A (2010) Botany for Degree Students – Gymnosperms, S. Chand and
8. Parihar NS (1976) Biology and Morphology of Pteridophytes. Central Book Depot.
9. Bhatnagar SP (1996) Gymnosperms, New Age International Publisher.
10. Pandey BP (2010) College Botany Vol II S. Chand and Company, New Delhi
11. Maheswari, P. 1971. An Introduction to Embryology of Angiosperms. McGraw Hill Book Co., London
12. Bhattacharya et. al. 2007. A textbook of Palynology, Central, New Delhi.
13. Bhojwani, S.S. and S. P. Bhatnagar. 2000. The Embryology of Angiosperms (4th Ed.), Vikas Publishing House,.
14. P.K.K. Nair- A textbook of Palynology.
15. Johri, B. M. 1984. Embryology of Angiosperms. Springer-Verleg, Berlin.
16. Dutta A.C. 2016. Botany for Degree Students. Oxford University Press.
17. E.J.Eames . Morphology of Vascular Plants, Standard University Press.
18. Dickinson, W.C. (2000). Integrative Plant Anatomy. Harcourt Academic Press, USA.
19. Fahn, A. (1974). Plant Anatomy. Pergmon Press, USA.
20. Evert, R.F. (2006) Esau's Plant Anatomy: Meristems, Cells, and Tissues of the Plant Body: Their Structure, Function and Development. John Wiley and Sons, Inc.

Suggested equivalent online courses:

https://www.anbg.gov.au/bryophyte/what-is-bryophyte.html
https://pteridoportal.org/portal/index.php
https://www.conifers.org/zz/gymnosperms.php
http://www.mobot.org/MOBOT/research/APweb/
https://milneorchid.weebly.com/plant-id-for-beginners.html
https://www.botany.org/PlantImages/PlantAnatomy.php
http://webapp1.dlib.indiana.edu/inauthors/view?docId=VAC0868&doc.view=print
https://palynology.org/
http://www2.estrellamountain.edu/faculty/farabee/biobk/Biobookflowers.html
https://www.sciencelearn.org.nz/resources/100-plant-reproduction
https://palaeobotany.org/

Suggested Continuous Evaluation Methods:
Total marks: 25
One Test/Assignments (hand written or typed 500 -1500 words)/Quizzes/ Presentation etc.(as decided by the teacher) carrying Maximum Marks 20 and a Viva-Voce/Class interaction of 5 marks

Programme/Class: Certificate	Year: I	Semester: II Paper-II (Practical)
Subject: Botany		
Course Code: BOTB202P	**Course Title: Land Plants Architecture**	

Course outcomes:

1. The students will be made aware of the group of plants that have given rise to land habit and the flowering plants. Through field study they will be able to see these plants grow in nature and become familiar with the biodiversity.
2. Students would learn to create their small digital reports where they can capture the zoomed in and zoomed out pictures as well as videos in case they are able to find some rare structure or phenomenon related to these plants.
3. Develop an understanding by observation and table study of representative members of phylogenetically important groups to learn the process of evolution in a broad sense.
4. Understand morphology, anatomy, reproduction and developmental changes therein through typological study and create a knowledge base in understanding plant diversity, economic values & taxonomy of lower group of plants
5. Understand the composition, modifications, internal structure &architecture of flowering plants for becoming a Botanist.

Credits: 2	Core Compulsory
Max. Marks **CIE: 25** Max. Marks **End Semester Examination:75** **Total Max. Marks: 100**	Min.Passing Marks **CIE:09** Min. Passing Marks **End Semester Examination: 26** **Total Min. Passing Marks: 35**

Total No. of Lectures-Tutorials-Practical (in hours per week): **0-0-2**

Unit	Suggested Lab / Virtual Experiments (Minimum Any Three from Each Unit Depending on Facilities)	No. of Lectures (60 Hrs)
I	**Bryophytes:** Marchantia- morphology of thallus, W.M. rhizoids and scales, V.S. thallus through Gemma cup, W.M. gemmae (all temporary slides), V.S. antheridiophore, archegoniophore, L.S. sporophyte (all permanent slides). Sphagnum- morphology, W.M. leaf, rhizoids, operculum, peristome, annulus, spores (temporary slides);permanent slides showing antheridial and archegonial heads, L.S. capsule and protonema.	**8**
II	**Pteridophytes:** Lycopodium: Habit, stem T. S. stobilus V. S., Selaginella: Habit, rhizophore T. S, stem T . S, axis with strobilus, V.S. of strobilus, Megasporophyll and microsporophyll. Equisetum - Habit, rhizome and stem T.S. and V. S. of strobilus. Azolla – Habitat & its structure	**7**
III	**Gymnosperms** 1. Cycas – seedling, coralloid root and coralloid root T. S., T. S. of leaflet and Rachis, micro and megasporophyll, male cone V. S., microsporophyll T. S. entire and V. S. of ovule. Pinus - Branch of indefinite growth, spur shoot, T. S of old stemand needle R.L.S and T. L. S. of stem, male and female cone, V.S. of male and female cone. 2. Ephedra & Thuja: Habit, stem T. S (young and mature), leaf T. S, male and female strobilus, V. S. of male and female cone, ovule V. S. and seed.	**8**
IV	**Palaeobotany & Palynology** 1. Morphology of Rhynia and fossils gymnosperms & other groups. 2. Visit Birbal Sahni Institute of Palaeosciences or virtual conference with their scientisto learn fossilization. 3. Mark and know about Indian geographical sites rich in plant fossils.	**6**
V	**Angiosperm Morphology** 1. To study diversity in leaf shape, size and other foliar features. 2. To study monopodial and sympodial branching. 3. Morphology of Fruits 4. Inflorescence types- study from fresh/ preserved specimens 5. Flowers- study of different types from fresh/ preserved specimens 6. Fruits- study from different types from fresh/preserved specimens 7. Study of ovules (permanent slides/ specimens/photographs)- types (anatropous,orthotropous, amphitropous and campylotropous) 8. Modifications in Roots,stems, leaves and inflorescences	**8**

VI	**Plant Anatomy:** Normal & Anomalous secondary thickening - *Bignonia, Dracaena, Boerhaavia diffusa, Nyctanthes* Study of primary and secondary growth in the root and stem of monocots and dicots by section cutting and permanent slides. Study of internal structure of dicot and monocot leaves. Study of structure of stomata.	**8**
VII	**Reproductive Botany** 1. Structure of anther, microsporogenesis and pollen grains 2. Structure of ovule and embryo sac development (through slides). 3. Study of embryo development in monocots and dicots. 4. Vegetative propagation by means of cutting, budding and grafting exercises. 5. Study of seed germination. 6. Study of pollen morphology of the following plants –*Hibiscus, Vinca, Balsam, Ixora, Crotalaria, Bougainvillea* by microscopic observation. 7. Calculation of pollen viability percentage using in vitro pollen germination techniques.	**8**
VIII	**Commercial Uses and Production technology** 1. *Azolla* production 2. Production technology of Resins 3. Production and propagation of Ornamental *Pteris*, Cycadales, Coniferales for landscaping. 4. Lab method for qualitative testing/ extraction of Ephedrine ,Taxol and *Thuja* oil.	**7**

Suggested Readings:

1. Pandey, BP and Trivedi, P.S. 1997. Botany Vol. I(10th edition). Vikas Publishing House.Pandey, BP; Misra; Trivedi, P.S. 1997. Botany Vol. II. Vikas Publishing House.
2. Pandey, BP and Chadha. 1997. Botany Vol. III. Vikas Publishing House.
3. Santra, SC and Chatterjee. 2005. College Botany Practical Vol. I. New Central Book Agency (P) Ltd.Kumar, S and Kashyap. 2003. Manual of Practical Algae. Campus Books International, New Delhi Bendre and Kumar A text book of Practical Botany. Vol I,II., Rastogi Pub. Meerut.
4. Suresh Kumar , Amar Singh Kashyap Manual of Practical Algae.. Campus Books Internet , New Delhi.
5. Santra, SC. 2005. College Botany Practical Vol. II. New Central Book Agency (P) Ltd.

Course prerequisites:

Qualification: To study this course, a student must have qualified 10+2 with Biology/ NSQF level 3 from Sector Skill Councils / Diploma holder from ITI in (Biology/ Agriculture/ Forestry).

Facilities: Smart and Interactive Class

Other Requisites: Microscopes, Stains, Dissection box, Haemocytometer, Specimens, Permanent slides, Autoclave, incubator, Oven, laminar flow cabinet, balance

Suggested equivalent online courses:

https://www.easybiologyclass.com/topic-botany
http://www3.botany.ubc.ca/bryophyte/index.html
http://ecflora.cavehill.uwi.edu/bio_courses/bl14apl/practical_3.1.htm
http://mydunotes.blogspot.com/p/botany.html
http://www.fao.org/3/a-v9236e.pdf
https://iinrg.icar.gov.in/library/nrg/nrg.pdf
https://agritech.tnau.ac.in/banking/nabard_pdf/Azolla%20Cultivation/Model_projct_on_Azolla_cultivation.pdf
http://arnoldia.arboretum.harvard.edu/pdf/articles/1977-37-1-propagation-manual-of-selected-gymnosperms.pdf
https://www.fs.fed.us/rm/pubs_other/wo_AgricHandbook730/wo_AgricHandbook727_153_175.pdf

Suggested Continuous Internal Evaluation(CIE)methods

Total marks: 25

One Practical Tests/Record/Chart/Model carrying Maximum Marks 20 and a Viva-Voce/Practical Class Interaction as decided by the concerned teacher/HOD) of 5 marks.

Programme /Class: Diploma	**Year: II**	**Semester: III Paper-I**

Subject: Botany	
Course Code: BOTB301T	**Course Title: Flowering Plants Identification & Aesthetic Characteristics**

Course outcomes:

After the completion of the course the students will be able to:

1. To gain an understanding of the history and concepts underlying various approaches to plant taxonomy and classification.
2. To learn the major patterns of diversity among plants, and the characters and types of data used to classify plants.
3. To compare the different approaches to classification with regard to the analysis of data.
4. To become familiar with major taxa and their identifying characteristics, and to develop in depth knowledge of the current taxonomy of a major plant family.
5. To discover and use diverse taxonomic resources, reference materials, herbarium collections, publications.
6. For the entrepreneur career in plants, one can establish a nursery, Start a landscaping business, Set up a farm Or Run a plantation consultancy firm

Credits: **4**	**Core Compulsory**
Max. Marks **CIE: 25** Max. Marks **End Semester Examination:75** **Total Max. Marks: 100**	Min.Passing Marks **CIE:09** Min. Passing Marks **End Semester Examination: 26** **Total Min. Passing Marks: 35**

Total No. of Lectures-Tutorials-Practical (in hours per week): **4-0-0**

Unit	Topic	No. of Lectures (60hrs)
I	**Taxonomic Resources & Nomenclature** Components of taxonomy (identification, nomenclature, classification) ; Taxonomic resources: Herbarium- functions & important herbaria, Botanical gardens, Flora, Keys- single access and multi-access. Principles and rules of Botanical Nomenclature according to ICN (ranks and names; principle of priority, binomial system; type method, author citation, valid-publication).	**7**
II	**Types of classification & Evidences** Artificial, natural and phylogenetic. Bentham and Hooker (upto series), Engler and Prantl (upto series) angiosperm phylogeny group (APG IV) classification. Introduction to taxonomic evidences from palynology, cytology, phytochemistry & Molecular biology data (Protein and Nucleic acid homology).	**8**
III	**Identification of Angiospermic families -I: (Families can be chosen University wise as per local available flora)** A study of the following families with emphasis on the morphological peculiarities and economic importance of its members (based on Bentham & Hooker's system) Ranunculaceae, Malvaceae, Rutaceae, Fabaceae, Myrtaceae , Cucurbitaceae, Rubiaceae, Asteraceae, Apocynaceae, Acanthaceae, Asclepiadaceae, Solanaceae.	**8**
IV	**Identification of Angiospermic families -II: (Families can be chosen University wise as per local available flora)** A study of the following families with emphasis on the morphological peculiarities and economic importance of its members (based on Bentham & Hooker's system)- Amaranthaceae, Euphorbiaceae, Papaveraceae, Apiaceae, Lamiaceae, Orchidaceae, Liliaceae, Musaceae, Poaceae.	**7**
V	**Modern trends in Plant taxonomy**: Brief idea on Phenetics, Biometrics, Cladistics (Monophyletic, polyphyletic and paraphyletic groups; Plesiomorphy and apomorphy).	**8**
VI	**TOOLS & SOFTWARES IN PLANT IDENTIFICATION-** GIS (Mapping of (i) Patterns(ii) Features (iii) Quantities 0P02.010H11YLIP - Free Phylogenetic Software, Digital Taxonomy (e-flora), Description Language for Taxonomy – DELTA Internet directory for botany.	**7**

VII	**Computer usage & Android Applications** MS Office: PPT, Microsoft Excel, data entry, graphs, aggregate functions, formulas and functions, number systems, conversion devices, secondary storage media. GPS tagging, Plant Identification Apps.	**7**
VIII	**Aesthetic Characteristics of Plants:** Aesthetic characteristics of plants, English, Italian, French, Persian, Mughal and Japanese gardens; Features of a garden (Garden wall, Fencing, Steps, Hedge, Edging, Lawn, Trees, shrubs and shrubberies, climbers and creepers, rockery, Flower beds, Shrubbery, Borders, Water garden). Some Famous gardens of India. Conservatory, green houses, Indoor garden, Roof garden, Topiary, Bonsai.	**8**

Suggested Readings:

1. Plant Systematic. Arun K. Pandey & Shruti Kansana. 2020. Jaya Publishing House.
2. Bole, P. V. and Vaghani, Y. (1986) Field guide to the common trees of I ndia. Oxford University Press; Bombay.
3. Brandis, D. (1906) Indian Trees (London, 5th edition. 1971). International Book Distributors; Dehra Dun.
4. Dallwitz, M. J., Paine, T. A. and Zurcher, E. J. (2003). Principles of interactive keys. http://delta-intkey.com
5. https://www.naace.co.uk/school-improvement/ict-mark/
6. https://www.socitm.gov.uk, (2002) Learning in the 21st century Executive briefing A Socitm Insight publication, July 2002 Socitm.
7. K. B. Anjaria, (2015)"Electronic Herbarium and Digital Database Preparation of Common Trees of Anand District, Gujarat" MRP submitted to UGC, WRO, Pune 2015 (unpublished)
8. Lizeron Eremias and R. Subash.(2013) "E-Content Development: A Milestone In The Dynamic Progress Of E-Learning" International Journal of Teacher Educational Research (IJTER) Vol.2 No.1 January, 2013 ISSN: 2319- 4642
9. Pandey, B.P. 2007. Botany for Degree Students: Diversity of Seed Plants and their Systematics, Structure, Development and Reproduction in Flowering Plants. S. Chand & Company Ltd,New Delhi.
10. Stace, C. A. 1989. Plant Taxonomy and Biostatistics (2nd Ed.). Edward Arnold, London.
11. Singh, G. 1999. Plant Systematics: Theory and Practice. Oxford and IBH, New Delhi.
12. Dutta A.C. 2016. Botany for Degree Students. Oxford University Press.
13. Davis, P. H. and V. H. Heywood. 1963. Principles of Angiosperm Taxonomy. Oliver and Boyd,London.
14. Heywood, V. H. and D. M. Moore (Eds). 1984. Current Concepts in Plant Taxonomy. Academic Press, London.
15. Austin, R. 2002. Elements of planting design. New York: John Wiley & Sons.
16. Bertauski, T. 2005. Designing the landscape: An introductory guide for the landscape designer. Upper Saddle River, NJ: Pearson Prentice Hall.
17. Thomas, H., and S. Wooster. 2008. The complete planting design course: Plans and styles for every garden. London: Octopus Publishing Group.
18. Scarfone, S. 2007. Professional planting design: An architectural and horticultural approach for creating mixed bed plantings. New York: John Wiley & Sons.
19. Randhawa, G.S. and Mukhopadhyay, A. 1986. Floriculture in India. Allied Publishers.

Suggested equivalent online courses:

https://www.easybiologyclass.com/topic-botany/
http://egyankosh.ac.in/handle/123456789/53530 https://www.delta-intkey.com/www/desc.htm https://milneorchid.weebly.com/plant-id-for-beginners.html https://plants.usda.gov/classification.html
https://www.senecahs.org/pages/uploaded_files/Plant%20Classification.pdf
https://www.ladykeanecollege.edu.in/files/userfiles/file/Dr_%20S_%20Nongbri%20III%20Sem%20ppt.pdf
https://www.brainkart.com/article/Bentham-and-Hooker-s-classification-of-plants---Dicotyledonae,-Gymnospermae-and-Monocotyledonae_1000/
https://libguides.rutgers.edu/c.php?g=336690&p=2267037
https://www.delta-intkey.com/

Suggested Continuous Evaluation Methods:

Total marks: 25

One Test/Assignments (hand written or typed 500 -1500 words)/Quizzes/ Presentation etc.(as decided by the teacher) carrying Maximum Marks 20 and a Viva-Voce/Class interaction of 5 marks

Programme/Class: : Diploma	Year: II	Semester: III Paper-II (Practical)
Subject: Botany		
Course Code: BOTB302P	Course Title: Plant Identification technology	

Course outcomes:

After the completion of the course the students will be able:

1. To learn how plant specimens are collected, documented, and curated for a permanent record.
2. To observe, record, and employ plant morphological variation and the accompanying descriptiveterminology.
3. To gain experience with the various tools and means available to identify plants.
4. To develop observational skills and field experience.
5. To identify a taxonomically diverse array of native plants.
6. To recognize common and major plant families.
7. To Understand aesthetic characters of flowering plants by making-landscapes,gardens,bonsai,miniatures
8. Comprehend the concepts of plant taxonomy and classification of Angiosperms.

Credits: 2	Core Compulsory
Max. Marks **CIE: 25** Max. Marks **End Semester Examination:75** **Total Max. Marks: 100**	Min.Passing Marks **CIE:09** Min. Passing Marks **End Semester Examination: 26** **Total Min. Passing Marks: 35**

Total No. of Lectures-Tutorials-Practical (in hours per week): **0-0-2**

	Unit	Suggested Lab/Virtual experiment *(Perform Any three experiments from each unit as per facility)	No. of Lecture (60Hrs)
	I	**Herbarium: Plant collecting, Preservation and Documentation:** Stepwise Practicing Herbarium techniques: a. FIELD EQUIPMENTS, Global Positioning System (GPS) instrument & Collection of any wild 25 plant specimens b. Learn to handle Herbarium making tools c. Pressing and Drying of collected plant specimens d. Special treatments for all varied groups of plants e. Mount on standard herbarium sheets f. Label them using Standard method g. Organize them and give Index Register Number	**7**
	II	**Taxonomic Identification using plant structure** a. Classify 25 plants on the basis of Taxonomic description (Plant Morphology, Anatomy, Reproductive parts, Habit, adaptation anomalies) according to Bentham and Hooker natura system of classification in the following families: Malvaceae, Fabaceae (Papilionaceae), Solanaceae, Scrophulariaceae, Acanthaceae, Labiatae (Lamiaceae), Rubiaceae.	**8**
	III	**Identification during excursions** a.Conducting Spot identification (Binomial, Family) of common wild plants from families included in the theoretical syllabus (list to be provided) and making FIELD NOTE BOOK and filling Sample of a page of field-book, used in Botanical Survey of India. b. Describe/compare flowers in semi-technical language giving V.S. of flowers, T.S. of ovaries, floral diagrams and Floral Formulae. Identify and assign them to their respective families giving reasons.	**8**
	IV	**COLLECTION, PRESERVATION AND STORAGE OF ALGAE, FUNGI BRYOPHYTES, PTERIDOPHYTES (Two each)**	**7**
	V	**Botanical Nomenclature & reporting Method:** **a.** Give nomenclature to collected plants as per ICN rules and prepare labels as per BSI **b. Author Citation, Effective Publication and Principle of Priority:** To show a specime paper on Basic structure of a taxonomic Research published on a new species in taxonomic journal	**7**
	VI	**COMPUTERS** 1. Learning to use EXCEL Microsoft PowerPoint and Word., WORKING WITH FOLDER AND WINDOWS UTILITY., CREATE AND MANAGE FILES AND FOLDER TREE,	**7**

		2. Practice browsing different sites using search engines. practice and understand different E-Mail services – Outlook, Yahoo mail, rediffmail etc.Practice Creating E-Mail accounts, Sending, Receiving & Storing of mails. 3. Create and Participate in virtual conferencing in an interactive Zoom Meeting	
	VII	**Computer Application in taxonomy** 1. Use Taxonomic Softwares (Dichotomous Key) 2 . Practicals on Phylogenetic analysis 3. Make line drawing of Plants for description 4.Using of plant identification apps on android phones	**8**
	VIII	1. Create a Bonsai of any plant 2. Develop a miniature garden 3. Draw Layouts of various types of gardens 4. Plant Propagation methods practice	**8**

Suggested Readings:

1. Day, S.C. (2003)A Art of Miniature Plant Culture. - Agrobios. Jodhpur, India.
2. Practical Taxonomy of Angiosperms By : R K Sinha ISBN : 9789386768520 I.K International Publishing House Pvt.Ltd.
1. Day, S.C. (2003)Complete Home Gardening. (2003) Agrobios, Jodhpur, India.
2. Dhopte, A.M. (2003) Principles and Techniques for Plant Scientists. - Agrobios,Jodhpur, India.
3. Khan, M.R. (1995) Horticulture and Gardening.- NiraliPrakashan, Pune. India.
4. PramilaMehra Gardening for everyone-. Hind pocket book private limited, New Dehli.
5. Kumarsen V. Horticulture ,Saras Publication
6. Ramesh Bangia Learning Computer Fundamentals.,., Khanna Book Publishers
7. Bose T.K. & Mukherjee, D., 1972, Gardening in India, Oxford & IBH PublishingCo., New Delhi.
8. Sandhu, M.K., 1989, Plant Propagation, Wile Eastern Ltd., Bangalore, Madras.
9. Randhawa, G.S. and Mukhopadhyay, A. 1986. Floriculture in India. Allied Publishers.
10. Bole, P. V. and Vaghani, Y. (1986) Field guide to the common trees of India. Oxford University Press;Bombay.
11. Womersley, J. S. 1981. Plant collecting and herbarium development: A manual.
12. Brandis, D. (1906) Indian Trees (London, 5th edition. 1971). International Book Distributors; DehraDu
13. Dallwitz, M. J., Paine, T. A. and Zurcher, E. J. (2003). Principles of interactive keys. http://delta-intkey.com https://www.naace.co.uk/school-improvement/ict-mark/
14. Manilal, K. S. and M. S. Muktesh Kumar (ed.) (1998) A Hand book of Taxonomy Training, DST,N.Delhi
15. Naik, V. N. (1984) Taxonomy of Angiosperms Tata McGrow-Hill Publication Com. Ltd., New Delhi
16. Primak, R. B. (2004) A Primer of Conservation Biology. Sinauer Associates, Inc. Publishers
17. Quicke, Donald, L. J. (1993) Principles and Techniques of Commemoratory Taxonomy. Blakie, Academic and Professional, London
18. Singh, G (2004) Plant Systematics:Theory and practice Oxford and YBH Publishing Co. Pvt. Ltd., New delhi.
19. Bridson, D. & L. Forman. eds. 1998. The Herbarium Handbook. 3rd ed. Royal Botanic Gardens,Kew(Reprinted 1999).
20. De Vogel, E.F. 1987. Manual of Herbarium Taxonomy: Theory and Practice. UNESCO, Jakarta.

Suggested equivalent online courses:

1. http://egyankosh.ac.in/bitstream/123456789/13096/1/Unit-5.pdf
2. https://www.for.gov.bc.ca/hfd/pubs/docs/wp/wp18.pdf
3. https://www.researchgate.net/publication/267510854_The_Flowering_Plants_Handbook

Suggested Continuous Internal Evaluation(CIE)methods

Total marks: 25

One Practical Tests/Record/Chart/Model carrying Maximum Marks 20 and a Viva-Voce/Practical Class Interaction as decided by the concerned teacher/HOD) of 5 marks.

Programme /Class*: Diploma*	Year: II	Semester: IV Paper-I
Subject: Botany		
Course Code: BOTB401T	**Course Title: Economic Botany, Ethnomedicine and Phytochemistry**	

Course outcomes:

After the completion of the course the students will be able to:

1. Understand about the uses of plants –will know one plant-one employment
2. Understand phytochemical analysis related to medicinally important plants and economicproducts produced by the plants
3. know about the importance of Medicinal plants and its useful parts, economically importantplants in our daily life and also about the traditional medicines and herbs, and its relevance in modern times.

Credits: 4	**Core Compulsory**
Max. Marks **CIE: 25** Max. Marks **End Semester Examination:75** **Total Max. Marks: 100**	Min.Passing Marks **CIE:09** Min. Passing Marks **End Semester Examination: 26** **Total Min. Passing Marks: 35**

Total No. of Lectures-Tutorials-Practical (in hours per week): **4-0-0**

Unit	Topic	No. of Lectures (60hrs)
I	**Origin and domestication of cultivated plants** Centers of diversity of plants, origin of crop plants. Domestication and introduction of crop plants. Concepts of sustainable development; cultivation, production and uses of Cereals, legumes, Spices & beverages.	**7**
II	**Botany of oils, Fibers, timber yielding plants & dyes** Study of the plants with Botanical names, Family, part used, and economic uses yielding Edible & essential oils; Sugar, Starch; Fibers; Paper, Fumitories & Masticatories, Rubber, Dyes, Timber, biofuel crops.	**7**
III	**Commercial production of Flowers, Vegetables, and fruits (To be Chosen area wise)** Commercial greenhouse cultivation of rose, Gerbera, Gladiolus, Anthurium/lilium/lily, tomato, bell pepper, cucumber, strawberry & Exotic leafy vegetables using Hydroponics.	**7**
IV	**IPR & Traditional Knowledge** IPR and WTO (TRIPS, WIPO), Patent Act 1970 and its amendments, TIFAC, NRDC, Rights, Procedure of obtaining patents, Working of patents, Infringement, Copyrights, Trademarks, Geographical Indications, Traditional Knowledge Digital Library, Protection of Traditional Knowledge & Protection of Plant Varieties and Biotech inventions.	**8**
V	**Ethnobotany** Methodologies of ethnobotanical research: Field work, Literature, Herbaria and Musea and other aspects of ethnobotany. Importance of ethnobotany in Indian systems of medicine (Siddha, Ayurveda and Unani), Role of AYUSH, NMPB, CI-MAP and CARI. Tribal knowledge towards disease diagnosis, treatment, medicinal plants, plant conservation and cultivation.	**8**
VI	**Medicinal aspects** Study of common plants used by tribes (*Aegle marmelos, Ficus religiosa, Cynodon dactylon, Eclipta alba, Oxalis, Ocimum sanctum* and *Trichopus zeylanicus)* Ethnobotanical aspect of conservation and management of plant resources, Preservation of primeval forests in the form of sacred groves of individual species and Botanical uses depicted in our epics. Plants in primary health care*:* common medicinal plants*: Tinospora, Acorus, Ocimum*, *Turmeric* and *Aloe*. Indian Pharmacopeia, Quality Evaluation of crude drugs & adulteration	**8**

VII	**Pharmacognosy** Preparation of drugs for commercial market - Organoleptic evaluation of drugs - Microscopic evaluation of drugs - Physical evaluation of drugs - Active and inert constituents of drugs - Classification of drug plants - individual drugs - drug adulteration. Sources of crude drugs – roots, rhizome, bulb, corm, leaves, stems, flowers, fruits and seeds ; organoleptic study of *Adhatoda vasica, Andrographis paniculata, Azadirachta indica, Coriandrum sativum, Datura metel, Eclipta alba, Emblica officinalis, Ocimum sanctum, Phyllanthus amarus, Ricinus communis, Vinca rosea* and *Zingiber officinale.*	**8**
VIII	**Herbal Preparations & Phytochemistry :** Collection of wild herbs - Capsules - compresses - Elixirs - Glycerites - Hydrotherapy or Herbal bath - Herbal oils - Liquid extracts or Tincture - Poultices - Salves - Slippery elm slurry and gruel - Suppositories - Teas. Plant natural products , general detection, extraction and characterization procedures. Glycosides and Flavonoids and therapeutic applications. Anthocyanins and Coumarins and therapeutic applications, Lignans, Terpenes, Volatile oils and Saponins, Carotenoids and Alkaloids Carotenoids and pharmacological activities.	**7**

Suggested Readings:

1. Kochhar, S.L. (2011). Economic Botany in the Tropics, MacMillan Publishers India Ltd., New Delhi. 4th edition.
2. Sambamurthy, AVSS & Subrahmanyam, NS (2000). Economic Botany of Crop Plants. Asiatech Publishers. New Delhi.
3. Singh, D.K and K.V. Peter. 2014. Protected cultivation of horticultural crops. New India Publishing Agency, India.
4. Reddy P. Parvatha. 2016. Sustainable crop protection under protected cultivation. Springer, Singapore.
5. Amit Deogirikar. 2019. A Text Book on Protected Cultivation and Secondary Agriculture. Rajlaxmi Prakashan, Aurangabad, India.
6. Singh, B., B. Singh, N. Sabir and M Hasan. 2014. Advances in protected cultivation. New India Publishing Agency, India.
7. Sharma, OP. 1996. Hill's Economic Botany (Late Dr. AF Hill, adopted by OP Sharma). Tata McGraw Hill Co. Ltd., New Delhi.
8. Joe J. Hanan. 1997. Greenhouses: Advanced Technology for protected horticulture. CRC Press.
9. Krishnamurthy, K.V. (2004). An Advanced Text rbook of Biodiversity - Principles and Practices. Oxford and IBH Publications Co. Pvt. Ltd. New Delhi
10. N.K. Acharya: Textbook on intellectual property rights, Asia Law House (2001).
11. Manjula Guru & M.B. Rao, Understanding Trips: Managing Knowledge in Developing Countries, Sage Publications (2003).
12. P. Ganguli, Intellectual Property Rights: Unleashing the Knowledge Economy, Tata McGraw-Hill (2001).
13. Arthur Raphael Miller, Micheal H.Davis; Intellectual Property: Patents, Trademarks and Copyright in a Nutshell, West Group Publishers (2000).
14. Jayashree Watal, Intellectual property rights in the WTO and developing countries, Oxford University Press, Oxford.
15. Jain, S. K. and V. Mudgal. 1999. A Handbook of Ethnobotany. Bishen Singh Mahendra Pal Singh,Dehradun.
16. Jeffrey, C. 1982. An Introduction to Plant Taxonomy. Cambridge University Press, Cambridge.London.
17. Joshi, S. G. 2000. Medicinal Plants. Oxford and IBH, New Delhi.
18. Kokate, C. and Gokeale- Pharmocognacy- Nirali Prakashan, NewDelhi.
19. Lad, V. 1984. Ayurveda – The Science of Self-healing. Motilal Banarasidass, New Delhi.
20. Lewis, W. H. and M. P. F. Elwin Lewis. 1976. Medical Botany. Plants Affecting Man's Health. A

a. Wiley Inter science Publication. John Wiley and Sons, New York.

21. Farooqui, A. A. and Sreeraman, B. S. 2001. Cultvation of medicinal and aromatic crops. Universities Press.
22. Harborne, J. B. 1998. Phytochemical methods – a guide to modern techniques of plant analysis 3 rd edition, Chapman and Hall.
23. Yesodha, D., Geetha, S and Radhakrishnan, V. 1997. Allied Biochemistry. Morgan publications, Chennai.1. Gurdeep Chatwal, 1980. Organic chemistry of natural productis. Vol. I. Himalaya Publishing house.
24. Kalsi, P. S. and Jagtap, S., 2012. Pharmaceutical medicinal and natural product chemistry. N.K. Mehra for Narosa Publishing House Pvt. Ltd. New Delhi.

25. Wallis, T. E. 1946. Text book of Pharmacognosy, J & A Churchill Ltd.
26. oseline, A. 2011. Pharmacognosy. MJP Publishers, Chennai.
27. Jain S. K. 1989. Methods and approaches in Ethnobotany, Society of Ethnobotanists, Lucknow.
28. Sharol Tilgner, N. D. 1999. Herbal medicine - From the heart of the earth.Edn. 1, Printed in the USA byMalloy Lithographing Inc.
29. Pal, D.C. & Jain, S.K., 1998. Tribal Medicine. Naya Prakash Publishers, Calcutta.
30. Datta & Mukerji, 1952. Pharmacognosy of Indian roots of Rhizoms drugs. Bulletin No.1 Ministry ofHealth, Govt. of India.
31. Young Ken, H.W., 1948. Text Book of Pharmacognosy. Blakiston C., Philadelphia.
32. Shukla, R.S., 2000. Forestry for tribal development. A.H. Wheeler & Co. Ltd., India.

Suggested Continuous Evaluation Methods:
Total marks: 25

One Test/Assignments (hand written or typed 500 -1500 words)/Quizzes/ Presentation etc.(as decided by the teacher) carrying Maximum Marks 20 and a Viva-Voce/Class interaction of 5 marks

Suggested equivalent online resourses: https://www.pnas.org/content/104/suppl_1/8641
https://www.journals.uchicago.edu/doi/pdfplus/10.1086/659998
https://bsi.gov.in/page/en/ethnobotany
http://www.legalserviceindia.com/article/l98-Intellectual-Property-and-Traditional-knowledge.html
https://www.brainkart.com/article/Economic-importance-Plants---Food,-Rice,-Oil,-Fibre,-Timber-yielding-plant_1095/
https://www.loc.gov/rr/scitech/tracer-bullets/economic-botanytb.html
http://nsdl.niscair.res.in/bitstream/123456789/127/1/Fibre%20crops%2C%20bamboo%2C%20timber%20-%20Final.pdf
https://www2.palomar.edu/users/warmstrong/econpls.htm
https://www.longdom.org/proceedings/phytochemistry-and-phytoconstituents-of-herbal-drugs-and-formulations-1668.htm

Programme: Diploma	Year: II	Semester: IV Paper-II
Subject: Botany		
Course Code: BOTB402P	Course Title: Commercial Botany & Phytochemical Analysis	

Course outcomes: After the completion of the course the students will be able to:

1. Know about the commercial products produced from plants.
2. Gain the knowledge about cultivation practices of some economic crops.
3. Understand about the ethnobotanical details of plants.
4. Learn about the chemistry of plants &herbal preparations
5. Can become a protected cultivator, aromatic oil producer, Pharmacologist or quality analyst in drug company.

Credits: 2	Core Compulsory
Max. Marks **CIE: 25** Max. Marks **End Semester Examination:75** **Total Max. Marks: 100**	Min. Passing Marks **CIE:09** Min. Passing Marks **End Semester Examination: 26** **Total Min. Passing Marks: 35**

Total No. of Lectures-Tutorials-Practical (in hours per week): **0-0-2**

Unit	Suggested lab/virtual experiment (Perform minimum any three experiments from each unit)	No. of Lectures (60hrs)
I	**Economic Botany & Microtechnique:** Cereals: Wheat (habit sketch, L.S./T.S. of grain, starch grains, micro-chemical tests); rice (habit sketch, study of paddy and grain, starch grains, micro-chemical tests) Legume: Pea or ground nut (habit, fruit, seed structure, micro-chemical tests) Source of sugars and starches: Sugarcane (habit sketch; cane juice- micro-chemical tests); potato (habit sketch, tuber morphology, T.S. of tuber to show localization of starch grains, W.M. of starch) grains, micro-chemical tests. Tea- tea leaves, tests for tannin Mustard- plant specimen, seeds, tests for fat in crushed seeds Timbers: section of young stem. Jute- specimen, transverse section of stem, tests for lignin on T.S. of stem and study offiber following maceration technique. Study of specimens of economic importance mentioned in Unit I-& II	**8**
II	**Commercial Cultivation** Field visit to Green houses for understanding Floriculture & vegetables production Development of hydroponics nutrient solutions & running models for cultivation of vegetables Development of hydroponics nutrient solutions & running models for cultivation of fodder	**8**
III	**Cultivating Medicinal and aromatic plants & Essential oil extraction** a. Lemon grass/ Neem/ Zinger /Rose/Mint	**7**
IV	**Documentation from** Traditional Knowledge Digital Library,Mark the Geographic Indications on Map, Understand –Nakshtra Vatika, Navgrah vatika and develop in your college To extract the names of the plants and Botanical uses depicted in our epics.Visit NISCAIR, New Delhi	**7**
V	**Ethnobotany** Study of common plants used by tribes. Aegle marmelos, Ficus religiosa, Cynodon dactylon. Visit a tribal area and collect information on their traditional method of treatment usingcrude drugs. Familiarize with at least 5 folk medicines and study the cultivation, extraction and its medicinal application. Observe the plants of ethnobotanical importance in your area. Visit to an Ayurveda college or Ayurvedic Research Institute / Hospital	**7**

VI	**Instrumentation and herbal Preparations** Develop Capsules of herbs/ Develop Herbal oils/ Develop Poultice/cream Analyse some active ingredients using chromatography /Spectrophotometry	**8**
VII	**Pharmacognosy** Organoleptic studies of plants mentioned in the theory : 1. Morphological studies of vegetative and floral parts. 2. Microscopic preparations of root, stem and leaf. 3. Stomatal number and stomatal index. 4. Vein islet number. 5. Palisade ratio. 6. Fibres and vessels (maceration). 7. Starch test 8. Proteins and lipid test	**8**
VIII	**Phytochemistry:** Determination of the percentage of foreign leaf in a drug composed of a mixture of leaves. Dimensions of Calcium oxalate crystals in powdered crude drug. Preliminary phytochemical tests for alkaloids, terpenoids, glycosides, volatile oils, tannins& resins. Any 5 herbal preparations.	**7**

Suggested Readings: ***Course Books published in Hindi may be prescribed by the Universities***.

1. Wallis, T. E. 1946. Textbook of Pharmacognosy, J & A Churchill Ltd.
2. Roseline, A. 2011. Pharmacognosy. MJP Publishers, Chennai.
3. Jain S. K. 1989. Methods and approaches in Ethnobotany, Society of Ethnobotanists, Lucknow.
4. Pal, D.C. & Jain, S.K., 1998. Tribal Medicine. Naya Prakash Publishers, Calcutta.
5. Datta & Mukerji, 1952. Pharmacognosy of Indian roots of Rhizome drugs. Bulletin No.1 Ministry of Health,Govt. of India.
6. Young Ken, H.W., 1948. Text Book of Pharmacognosy. Blakiston C., Philadelphia.
7. Shukla, R.S., 2000. Forestry for tribal development. A.H. Wheeler & Co. Ltd., India.
8. Raychudhuri, S.P., 1991. (Ed.) Recent advances in Medicinal aromatic and spice crops. Vol.1,Today&Tomorrow's printers and publishers, New Delhi.
9. Khasim S.M Botanical Microtechniques: Principles and Practice-
10. Sambamurthy, AVSS & Subrahmanyam, NS (2000). Economic Botany of Crop Plants. Asiatech Publishers.ew Delhi.
11. Singh, D.K and K.V. Peter. 2014. Protected cultivation of horticultural crops. New India Publishing Agency

Suggested Continuous Internal Evaluation(CIE)methods

Total marks: 25

One Practical Tests/Record/Chart/Model carrying Maximum Marks 20 and a Viva-Voce/Practical Class Interaction as decided by the concerned teacher/HOD) of 5 marks.

Suggested equivalent online courses:

https://www.entrepreneurindia.co/Document/Download/pdfanddoc-144615-.pdf
http://nopr.niscair.res.in/handle/123456789/45825
https://www.wipo.int/export/sites/www/tk/en/resources/pdf/medical_tk.pdf
https://www.bentoli.com/commercial-farming-agriculture/

Programme/Class: Degree	Year: III	Semester: V Paper-I
Subject: BOTANY		
Course Code: BOTB501T	Course Title: Plant Physiology, Metabolism & Biochemistry	

Course outcomes:

After the completion of the course the students will be able to:

1. Understand the role of Physiological and metabolic processes for plant growth and development.
2. Learn the symptoms of Mineral Deficiency in crops and their management.
3. Assimilate Knowledge about Biochemical constitution of plant diversity.
4. Know the role of plants in development of natural products, nutraceuticals, dietary supplements,antioxidants

Credits: 4	Core Compulsory
Max. Marks **CIE: 25** Max. Marks **End Semester Examination:75** **Total Max. Marks: 100**	Min.Passing Marks **CIE:09** Min. Passing Marks **End Semester Examination: 26** **Total Min. Passing Marks: 35**

Total No. of Lectures-Tutorials-Practical (in hours per week) 4-**0-0**

Unit	Topic	No. of Lectures(60hrs)
I	**Plant water relation, Mineral Nutrition, Transpiration and translocation in phloem** Importance of water, water potential and its components; Transpiration and its significance; Factors affecting transpiration; Root pressure and guttation. Criteria of essentiality of elements; Role of essential elements; Symptoms of mineral deficiency in major crops, Transport of ions across cell membrane, active and passive transport, Composition of phloem sap, girdling experiment; Pressure flow model.	**7**
II	**Carbon Oxidation** Krebs cycle, Glycolysis, fate of pyruvate- aerobic and anaerobic respiration and fermentation, regulation of glycolysis, oxidative pentose phosphate pathway, oxidative decarboxylation of pyruvate, regulation of Krebs cycle, mitochondrial electron transport, oxidative phosphorylation, ATP-Synthetase, Chemiosmotic mechanism, P/O ratio, cyanide-resistant respiration, factors affecting respiration.	**7**
III	**Nitrogen Metabolism** Nitrate assimilation, biological nitrogen fixation (examples of legumes and non-legumes), Physiology and biochemistry of nitrogen fixation, Ammonia assimilation (GS-GOGAT), reductive amination and transamination, amino acid synthesis.	**8**
IV	**Lipid Metabolism & Photosynthesis** Lipid Metabolism: Synthesis and breakdown of triglycerides, -oxidation, glyoxylate cycle, gluconeogenesis and its role in mobilization of lipids during seed germination, -oxidation. ; Photosynthesis: Pigments, Action spectra and Enhancement effect, Electron transport system and Photophosphorylation, C3 & C4 photosynthesis, CAM- Reaction and Significance	**7**
V	**Plant Development, Movements, Dormancy & Responses** Developmental roles of Phytohormones (auxins, gibberellins, cytokinins, ABA, ethylene.) autonomic & paratonic movements, Control and Coordination in plants, Photoperiodism (SDP, LDP, Day neutral plants); Phytochrome (discovery and structure), red and far red-light responses on photomorphogenesis, Seed physiology & Dormancy, Vernalization & Senescence	**8**

VI	**Biomolecules** *Carbohydrates:* Nomenclature and classification; Role of monosaccharides (glucose, fructose, sugar alcohols – mannitol and sorbitol); Disaccharides (sucrose, maltose, lactose), Oligosaccharides and polysaccharides (structural-cellulose, hemicelluloses, pectin, chitin, mucilage; storage – starch, inulin). *Lipids*: Storage lipids: Fatty acids structure and functions, Structural lipids: Phosphoglycerides; Lipid functions: cell signals, cofactors, prostaglandins, Introduction of lipid micelles, monolayers, bilayers	**8**
VII	**Proteins**: Structure of amino acids; Peptide bonds; Levels of protein structure-primary, secondary, Ramchandran plot,tertiary and quaternary; Isoelectric point; Protein denaturation and biological roles of proteins **Nucleic acids:** Structure of nitrogenous bases; Structure and function of nucleic acids,Nucleic acid denaturation &Re-naturation , MiRNA	**7**
VIII	**Enzymes:** Structure of enzyme: holoenzyme, apoenzyme, cofactors, coenzymes and prosthetic group; mechanism of action (activation energy, lock and key hypothesis, induced- fit theory), enzyme inhibition and factors affecting enzyme activity, Allosteric enzymes & Abzymes. Phytonutrients, Nutraceuticals, dietary supplements and antioxidants.	**8**

Suggested Readings:

1. Hopkins, W.G. & Hiiner, N.P. Introduction to Plant Physiology (3rd ed.) 2004, John Wiley & Sons.
2. A Handbook On Mineral Nutrition And Diagnostic Techniques For Nutritional Disorders Of Crops (pb)ISBN : 9788177543377Edition : 01Year : 2011Author : Pathmanabhan G , Vanangamudi M , Chandrasekaran CN , Sathyamoorthi K , Babu CR , Babu RC , Boopathi PNPublisher : Agrobios (India)
3. Jain, V.K. Fundamental of Plant Physiology (7th ed.) 2004. S. Chand and Company.
4. Salisbury, F.B. & Ross, C.W. Plant Physiology (4th ed.), 19992, Wadsoworth Publishing Company.
5. Panday, S.N. & Sinha, B.K. Plant Physiology (4th ed.), 2006, Vikas Publishing House Pvt. Ltd.
6. Mukherjee, S. & Ghosh, A. Plant Physiology (2nd ed.), 2005, New Central Book Agency.
7. Chaudhuri, D., Kar, D.K., and Halder, S.A. Handbook of Plant Biosynthetic Pthways 2008, New CentralBook. Agencies.
8. Voet, D. and Voet, J.G., Bio-Chemistry (3rd ed.), 2005, John Wiley & Sons.
9. Mathews, C.K., Van Holder, K.E. & Ahren, K.G. Bio-Chemistry (3rd ed.), 2000, Pearson Education.
10. Lehninger Principles of Biochemistry. Sixth Edition. 2013. David L. Nelson, Michael M. Cox. Freeman, Macmillan.
11. Srivastava, HN. 2006. Pradeep's Botany Vol. V. Pradeep Publications, Jalandhar.
12. Verma, SK. Plant Physiology and Biochemistry. S. Chand & Sons, New Delhi.
13. Buchanon, Gruissen and Jones. Plant Physiology & Biochemistry: Biochemistry and Molecular Biology of plants, 2000, I.K. International.
14. Ramesh Gupta. Efficacy, Safety and Toxicity brings together all current knowledge regarding nutraceuticals and theirpotential toxic effects. 2016. Elsevier.
15. Harborne,J.B.1973 .Phytochemical Methods. John Wiley & Sons, New York.
16. Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., and Losick, R., 2008 Molecular Biology of the Gene 6thedition. Cold Spring Harbour Lab. Press, Pearson Pub.
17. P.K. Gupta. BIOTECHNOLOGY AND GENOMICS. Rastogi Publications, 7th Reprint (1st Edition): 2016-2017

Suggested equivalent online courses: https://www.classcentral.com/course/swayam-plant-physiology-and-metabolism-17732 https://www.wiziq.com/course/3249-plant-physiology-in-10-live-online-classes
https://www.easybiologyclass.com/plant-physiology-free-lecture-notes-online-tutorials-lecture-notes-ppts-mcqs/
https://onlinecourses.swayam2.ac.in/cec19_bt09/preview

Suggested Continuous Evaluation Methods:
Total marks: 25
One Test/Assignments (hand written or typed 500 -1500 words)/Quizzes/ Presentation etc.(as decided by the teacher) carrying Maximum Marks 20 and a Viva-Voce/Class interaction of 5 marks

Programme: Degree	Year: III	Semester: V Paper-II
Subject: BOTANY		
Course Code: BOTB502T	**Course Title: Molecular Biology & Bioinformatics**	

Course outcomes:

After the completion of the course the students will be able to:

1. Understand nucleic acids, organization of DNA in prokaryotes and Eukaryotes, DNA replication mechanism, genetic code and transcription process.
2. Know about Processing and modification of RNA and translation process, function and regulation of expression.
3. Gain working knowledge of the practical and theoretical concepts of bioinformatics

Credits: 4	**Core Compulsary**
Max. Marks **CIE: 25** Max. Marks **End Semester Examination:75** **Total Max. Marks: 100**	Min.Passing Marks **CIE:09** Min. Passing Marks **End Semester Examination: 26** **Total Min. Passing Marks: 35**

Total No. of Lectures-Tutorials-Practical (in hours per week) 4-**0**-**0**

Unit	Topic	No. of Lectures(60hrs)
I	**Genetic material** Miescher to Watson and Crick- historic perspective, Griffith's and Avery's transformation experiments, Hershey-Chase, bacteriophage experiment, DNA structure, types of DNA, types of genetic material. DNA replication (Prokaryotes and eukaryotes): semi–conservative. DNA replication (Prokaryotes and eukaryotes): bidirectional replication, semi–conservative, semi discontinuous RNA priming, Ø (theta) mode of replication, replication of linear, dsDNA, replicating the 5′ end of linear chromosome including replication enzymes.	**7**
II	**Transcription & Regulation of gene expression** Types of structures of RNA (mRNA, tRNA, rRNA), RNA polymerase- various types; Translation, (Prokaryotes and eukaryotes), genetic code. Regulation of gene expression in Prokaryotes: Lac operon and Tryptophan operon; and in Eukaryotes	**7**
I II	**Principles & Techniques of genetic engineering** Blotting techniques: Northern, Southern and Western Blotting, DNA Fingerprinting; Molecular DNA markers i.e. RAPD, RFLP, SNPs; DNA sequencing, PCR and Reverse Transcriptase-PCR. Hybridoma and monoclonal antibodies, ELISA and Immunodetection. Antibody Engineering.	**8**
IV	**Applications of Genetic engineering** Pest resistant (Bt-cotton); herbicide resistant plants (RoundUp Ready soybean); Transgenic crops with improved quality traits (Flavr Savr tomato, Golden rice); Improved horticultural varieties (Moondust carnations); Role of transgenics in bioremediation (Superbug); Industrial enzymes (Aspergillase, Protease, Lipase); Genetically Engineered Products, Biosafety concerns..	**7**
V	**Bioinformatics & its applications** Computer fundamentals - programming languages in bioinformatics, role of supercomputers in biology. Historical background. Scope of bioinformatics - Genomics, Transcriptomics, Proteomics, Metabolomics, Molecular Phylogeny, computer aided Drug Design (structure based and ligand based approaches), Systems Biology and Functional Biology. Applications and Limitations of bioinformatics.	**8**

VI	**Biological databases :** Introduction to biological databases - primary, secondary and composite databases, NCBI, nucleic acid databases (GenBank, EMBL, DDBJ, NDB), protein databases (PIR, Swiss-Prot, TrEMBL, PDB), metabolic pathway database (KEGG, EcoCyc, and MetaCyc), small molecule databases (PubChem,)	**8**
VII	**Data Generation and Data Retrieval** Generation of data (Gene sequencing, Protein sequencing, Mass spectrometry, Microarray), Sequence submission tools (BankIt, Sequin, Webin); Sequence file format (flat file, FASTA, GCG, EMBL, Clustal, Phylip, Swiss-Prot); Sequence annotation; Data retrieval systems (SRS, Entrez)	**7**
VIII	**Phylogenetic analysis** Similarity, identity and homology, Alignment – local and global alignment, pairwise and multiple sequence alignments, alignment algorithms. Methods of Alignment (Dot matrix, Dynamic Programming, BLAST and FASTA); Phylogenetic analysis: Construction of phylogenetic tree, dendrograms, methods of construction of phylogenetic trees.	**8**

Suggested Books

1. Primrose, SB. 1995. Principles of Genome Analysis. Blackwell Science Ltd.Oxford, UK..
2. E.J. Gardner and D.P. Snustad. PRINCIPAL OF GENETICS (1984), John Wiley & Sons, Ney York.
3. Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., and Losick, R., 2008 Molecular Biology of the Gene 6th edition. Cold Spring Harbour Lab. Press, Pearson Pub.
4. Freifelder - Molecular Biology.
5. P.K. Gupta. BIOTECHNOLOGY AND GENOMICS. Rastogi Publications, 7th Reprint (1st Edition): 2016-2017.
6. Ghosh, Z., Mallick, B. (2008). Bioinformatics – Principles and Applications, 1st edition. New Delhi, Delhi: Oxford University Press.
7. Baxevanis, A.D. and Ouellette, B.F., John (2005). Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, 3rd edition. New Jersey, U.S.: Wiley & Sons, Inc.
8. Roy, D. (2009). Bioinformatics, 1st edition. New Delhi, Delhi: Narosa Publishing House.
9. Andreas, D., Baxevanis, B.F., Francis, Ouellette. (2004). Bioinformatics: A practical guide to the analysis of genes and proteins, 3rd edition. New Jersey, U.S.: John Wiley and Sons.
10. Pevsner J. (2009). Bioinformatics and Functional Genomics, 2nd edition. New Jersey,U.S.: Wiley Blackwell.
11. Xiong J. (2006). Essential Bioinformatics,1st edition. Cambridge, U.K.: Cambridge University Press

A Textbook Of Basic And Molecular Genetics (pb)ISBN : 9788188826193Edition : 01Year : 2018Author : Dr. Parihar

Suggested equivalent online courses:

https://www.edx.org/learn/molecular-biology
https://www.vlab.co.in/broad-area-biotechnology-and-biomedical-engineering
https://www.classcentral.com/course/swayam-genetic-engineering-theory-and-application-14090
https://www.coursera.org/courses?query=genetics
https://www.coursera.org/courses?query=molecular%20biology https://www.edx.org/learn/genetic-engineering
https://www.mooc-list.com/tags/genetic-engineering
https://www.classcentral.com/course/edx-molecular-biology-part-1-dna-replication-and-repair-2907
https://nptel.ac.in/courses/102/103/102103013/

Suggested Continuous Evaluation Methods:

Total marks: 25

One Test/Assignments (hand written or typed 500 -1500 words)/Quizzes/ Presentation etc.(as decided by the teacher) carrying Maximum Marks 20 and a Viva-Voce/Class interaction of 5 marks

Programme/Class: Degree	Year: III	Semester: V Paper-III
Subject: Botany		
Course Code: BOTB503P	Course Title: Experiments in physiology, Biochemistry & molecular biology	

Course outcomes:

After the completion of the course the students will be able to:

1. Know and authentic the physiological processes undergoing in plants along withtheir metabolism
2. Identify Mineral deficiencies based on visual symptoms
3. Understand and develop skill for conducting molecular experiments for geneticengineering

Credits: 2	Core Compulsory
Max. Marks **CIE: 25** Max. Marks **End Semester Examination:75** **Total Max. Marks: 100**	Min.Passing Marks **CIE:09** Min. Passing Marks **End Semester Examination: 26** **Total Min. Passing Marks: 35**

Total No. of Lectures-Tutorials-Practical (in hours per week) 0-0-2

Unit	Suggested lab/virtual experiment (Perform minimum any three experiments from each unit)	No. of Lectures(60 hrs)
I	Plant water relation, Mineral Nutrition and translocation in phloem 1. Determination of osmotic potential of plant cell sap by plasmolytic method using leaves of Rhoeo / Tradescantia. 2. Osmosis – by potato osmoscope experiment 3. Effect of temperature on absorption of water by storage tissue and determination of Q10. 4. Experiment to demonstrate the transpiration phenomenon with the bell jar method 5. Experiment for demonstration of Transpiration by Four-Leaf Experiment: 6. Structure of stomata (dicot & monocot) 7. Determination of rate of transpiration using cobalt chloride method. 8. Experiment to measure the rate of transpiration by using Farmer's Potometer 9. Experiment to measure the rate of transpiration by using Ganong's potometer 10. Effect of Temperature on membrane permeability by colorimetric method. 11. Study of mineral deficiency symptoms using plant material/photographs.	8
II	Nitrogen Metabolism, Photo Synthesis & Respiration 1. A basic idea of chromatography: Principle, paper chromatography and column chromatography; demonstration of column chromatography. 2. Separation of plastidial pigments by solvent and paper chromatography. 3. Estimation of total chlorophyll content from different chronologically aged leaves (young,mature and senescence) by Arnon method. 4. Effect of HCO_3 concentration on oxygen evolution during photosynthesis in an aquatic plant and to find out the optimum and toxic concentration (either by volume measurement orbubble counting). 5. Measurement of oxygen uptake by respiring tissue (per g/hr.)6.Determination of the RQ of germinating seeds. 7. Effect of light intensity on oxygen evolution in photosynthesis using Wilmott' bubble	8
III	Plant Development, Movements, Dormancy & Responses 1. Geotropism and phototropism — Klinostàt 2. Hydrotropism a. Measurement of growth — Arc and Liver Auxonometer 3. To study the phenomenon of seed germination (effect of light). 4. To study the induction of amylase activity in germinating grains.	8

	5. Test of seed viability by TTC method. *6.* To study the effect of different concentrations of IAA on *Avena* coleoptile elongation (IAA bioassay)	
IV	**Techniques for biochemical analysis** 1. Weighing and Preparation of solutions -percentage, molar & normal solutions, dilution from stock solution etc. 2. Separation of amino acids by paper chromatography. 3. Detection of organic acids: citric, tartaric, oxalic and malic from laboratory samples., 4. Qualitative Analysis of carbohydrates, 5. Estimation of reducing sugar by anthrone method, 6. Qualitative Analysis of Lipids 7. Qualitative analysis of Amino acids and Proteins 8. Quantitative Analysis of Nucleic Acids, 9. Analysis of dietary supplements, nutraceuticals & antioxidants 10. Testing of adulterants in food items.	**8**
V	**Genetic material** 1. Instruments and equipments used in molecular biology. 2. Preparation of LB medium and cultivating E.coli on it. 3. Isolation of Genomic DNA 4. Isolation of DNA from plants 5. Examination of the purity of DNA by agarose gel electrophoresis. 6. Quantification of DNA by UV-spectrophotometer 7. Estimation of DNA by diphenylamine method.	**7**
VI	**Preparation of models/ charts:** 1. Study of experiments establishing nucleic acid as genetic material (Avery et al, Griffith's, Hershey & Chase's and Fraenkel & Conrat's experiments)through photographs 2. Numericals based on DNA re-association kinetics (melting profiles and Cotcurves) 3. Study of DNA replication through photographs: Modes of replication - Rolling circle, Theta and semi-discontinuous ; Semiconservative model of replication (Messelson and Stahl's experiment); Telomerase assisted end-replication of linearDNA 4. Study of structures of : tRNA (2D and 3D); prokaryotic RNA polymerase and eukaryotic RNA polymerase II through photographs 5. Study of the following through photographs: Assembly of Spliceosome machinery; Splicing mechanism in group I & group II introns; Ribozymes and Alternative splicing 6. Understanding the regulation of lactose (lac) operon (positive & negative regulation) and tryptophan (trp) operon (Repression and De-repression & Attenuation) through photographs. 7. Understanding the mechanism of RNAi by photographs	**7**
VII	**Genetic Engineering** 1. Isolation of protoplasts. 2. Construction of restriction map of circular and linear DNA from the data provided. 3. Isolation of plasmid DNA. 4. Restriction digestion and gel electrophoresis of plasmid DNA (demonstration/ photograph). 5. Calculate the percentage similarity between different cultivars of a species using RAPD profile. Construct a dendrogram and interpret results.	**7**

	6. Agarose gel analysis of plasmid DNA 7. Restriction digestion of plasmid DNA -Demonstration of PCR	
VIII	**Applications of Genetic engineering** 1. ELISA Test, 2. Viability tests of cells 3. Study of methods of gene transfer through photographs: Agrobacterium- mediated, direct gene transfer by electroporation, microinjection, microprojectile bombardment. 4. Study of steps of genetic engineering for production of Bt cotton, Golden rice, FlavrSavr tomato through photographs.	**7**

Suggested Readings:

1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley &Sons. Inc.
2. A Laboratory Manual Of Plant, Physiology, Biochemistry And Ecology ISBN : 9788177544589Edition : 01Year : 2012Author : Akhtar InamPublisher : Agrobios (India)
3. Advanced Methods In Physiology And Biochemistry (pb)ISBN : 9789381191132Edition : 01Year : 2016Author : Padmanaban G , Chandrasekaran CN , Thangavelu AU , Dr. Sivakumar R , Kalimuthu N , Dr. Boominathan P , Dr. Anbarasan P,Agrobios.
4. Methods in Plant Biochemistry and Molecular Biology. 1997. Dashek, WV (ed.). CRC Press.
5. Wilson and Walker .Practical Biochemistry: Principles and Techniques. Cambridge UniversityPress.U.K.
6. Thimmaiah, SR. 2004. Standard Methods of Biochemical Analysis. Kalyani Publishers.
7. Henry, RJ. 1997. Practical Application of Plant Molecular Biology. Chapman & Hall, London
8. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley &Sons. Inc.
9. A Laboratory Manual Of Plant, Physiology, Biochemistry And Ecology ISBN : 9788177544589Edition
10. : 01Year : 2012Author : Akhtar InamPublisher : Agrobios (India)
11. Advanced Methods In Physiology And Biochemistry (pb)ISBN : 9789381191132Edition : 01Year : 2016Author : Padmanaban G , Chandrasekaran CN , Thangavelu AU , Dr. Sivakumar R , Kalimuthu N
12. , Dr. Boominathan P , Dr. Anbarasan P,Agrobios.
13. Methods in Plant Biochemistry and Molecular Biology. 1997. Dashek, WV (ed.). CRC Press.
14. Wilson and Walker .Practical Biochemistry: Principles and Techniques. Cambridge UniversityPress.U.K.
15. Thimmaiah, SR. 2004. Standard Methods of Biochemical Analysis. Kalyani Publishers.
16. Henry, RJ. 1997. Practical Application of Plant Molecular Biology. Chapman & Hall, London

Suggested Continuous Internal Evaluation(CIE)methods

Total marks: 25

One Practical Tests/Record/Chart/Model carrying Maximum Marks 20 and a Viva-Voce/Practical Class Interaction as decided by the concerned teacher/HOD) of 5 marks.

Programme/Class: Degree	Year: III	Semester: VI Paper-I
Subject: Botany		
Course Code: BOTB601T	**Course Title: Cytogenetics, Plant Breeding & Nanotechnology**	

Course outcomes: After the completion of the course the students will be able:

1. Acquire knowledge on cell ultrastructure.
2. Understand the structure and chemical composition of chromatin and concept of cell division.
3. Interpret the Mendel's principles, acquire knowledge on cytoplasmic inheritance and sex-linked inheritance.
4. Understand the concept of 'one gene one enzyme hypothesis' along with the molecular mechanism of mutation.

Credits: 4	**Core Compulsory**
Max. Marks **CIE: 25**	Min.Passing Marks **CIE:09**
Max. Marks **End Semester Examination:75**	Min. Passing Marks **End Semester Examination: 26**
Total Max. Marks: 100	**Total Min. Passing Marks: 35**

Total No. of Lectures-Tutorials-Practical (in hours per week): **4-0-0**

Unit	Topic	No. of Lectures (60hrs)
I	**Cell biology** Structure and function of cell wall, plasma membrane, ribosomes, Endoplasmic reticulum, golgi apparatus, mitochondria, chloroplast, lysosomes, peroxisomes and cell inclusions - Organization of nucleus: nuclear envelope, nucleoplasm and nucleolus. Chromosomal nomenclature- chromatids, centromere, telomere, satellite, secondary constriction.Organization of chromosomes- Nucleic acid and histones- types and classification. Lampbrush chromosomes and polytene chromosomes- Karyotype and idiogram.Cell cycle: G0, G1, S and G2 phases – mitosis: open and closed mitosis – amitosis - meiosis. Variation in Chromosome number (Numerical aberrations)- anueploidy and Euploidy-haploidy, polyploidy- significance (Structural aberrations) - deletion, duplication, inversion and translocation.	**8**
II	**Genetics** Chromosome theory of inheritance, crossing over and linkage; Incomplete dominance and codominance; Interaction of Genes; Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, Polygenic inheritance; Extra-nuclear Inheritance, Linkage, crossing over, Concept of sex determination and Sex chromosomes; Patterns of Sex determination in plants	7
III	**Plant breeding** Plant introduction. Agencies of plant introduction in India, Procedure of introduction - Acclimatization – Achievements, Selection - mass selection, pure line selection and clonal selection. Genetic basis of selection methods, Hybridization: Procedure of hybridization, inter generic, inter specific, inter varietal hybridization with examples. Composite and synthetic varieties, Male sterility, Heterosis and its exploitation in plant breeding, Mutation, Molecular Breeding (use of DNA markers in plant breeding), achievements in India, Breeding for pest, pathogenic diseases and stress resistance.	8
IV	**Biostatistics:** Definition, statistical methods, basic principles, variables- measurements, functions, limitations and uses of statistics. Biometry: Data, Sample, Population, random sampling, Frequency distribution- definition only, Central tendency– Arithmetic Mean, Mode and Median; Measurement of dispersion–Coefficient of variation, Standard Deviation, Standard error of Mean; Test of significance: chi- square test for goodness of fit. Computer application in biostatistics - MS Excel and SPSS	7
V	**Plant tissue culture**	8

	Principles, components and techniques of *in vitro* plant cultures, Callus cultures, Cell culture, cell suspension cultures, Embryogenesis and organogenesis, Protoplast isolation and culturing of protoplast- principle and application, regeneration of protoplasts, protoplast fusion and somatic hybridization- selection of hybrid cells, Somaclonal variation, Plant secondary metabolites production.	
VI	**Nanotechnology** Fundamentals of nanoscale self-assembly process involved in important functional biomolecules such as Nucleic acid (DNA and RNA), Proteins, Enzymes. Cell structure and organelles, nanoscale assembly of cellular components (cell membrane and liposomes). Nanoscale assembly of microorganisms (virus). Nano-particles synthesis, Biological synthesis of Nanoparticles, Advantages and applications of biologically synthesized nanomaterials. Introduction to biological nanomaterials. Biomineralization, Magnetosomes, nano-pesticides, nano-fertilizers, nano-sensors.	**7**
VII	**Artificial Intelligence in Plant Sciences** Big Data Analytics, Blockchain Technology, 3-D Printing, Machine learning, Algorithms of Machine Learning, Expert systems and Fuzzy logic , Artificial Neural Networks and Genetic algorithms, Predictive Analytics, Agents and Robotics, IoT Sensors, Object Image capture & analysis ; Applications of Artificial Neural Networks in Plant Science.	**8**
VIII	**Introduction to use of Digital technologies – AI, IoT & ICT in Botany** Educational software- INFLIBNET, NICNET, BRNET, internet as a knowledge repository-google scholar, science direct. resource management, weather forecasting. IoT Database management, IoT platforms, IoT Graphical user interface • IoT application development for Android Mobile phones, ICT Applications for different crops and horticulture	**7**

Suggested Readings:

1. G.M. Cooper. (2015). The cell: A Molecular Approach. 7th Edition. Sinauer Associates.
2. Alberts, B., Johnson, A.D., Lewis, J., Morgan, D., Raff, M., Roberts, K., Walter, P. (2014). Molecular Biology of Cell. 6th Edition. WW. Norton & Co.
3. Campbell, M.K. (2012) Biochemistry, 7th ed., Published by Cengage Learning.
4. Campbell, P.N. and Smith, A.D. (2011). Biochemistry Illustrated, 4th ed., Published by Churchill Livingstone
5. Tymoczko, J.L., Berg, J.M. and Stryer, L. (2012). Biochemistry: A short course, 2nd ed., W.H.Freeman.
6. Berg, J.M., Tymoczko, J.L. and Stryer, L. (2011) Biochemistry, W.H.Freeman and Company
7. Nelson, D.L. and Cox, M.M. (2008). Lehninger Principles of Biochemistry, 5th Ed., W.H. Freeman and Company.
8. Karp, G. (2010). Cell Biology, John Wiley & Sons, U.S.A. 6th edition.
9. Hardin, J., Becker, G., Skliensmith, L.J. (2012). Becker's World of the Cell. 8th edition.Pearson Education Inc. U.S.A.)
10. Gardner, E.J., Simmons, M.J., Snustad, D.P. (1991). Principles of Genetics, John Wiley & sons, India. 8th e
11. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics, John Wiley & Sons Inc., India.5th edition.
12. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. Benjamin Cummings, U.S.A..
13. Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J. (2010). Introduction to Genetic Analysis. W. H. Freeman and Co., U.S.A. 10th edition.
14. M K Raxdan An Introduction to Plant Tissue Culture –; Oxfird & IBH Publishing Co.Pvt. Ltd.,New Delhi
15. Aggarwal SK (2009) Foundation Course in Biology, 2nd Edition, Ane Books Pvt. Ltd
16. Allard RW (1960) Principles of Plant Breeding. John willey and Sons. Inc. New York
17. BD Singh (2003) Plant Breeding. Kalyani Publishers
18. Cohn, N.S. (1964) Elements of Cytology. Brace and World Inc, New Delhi
19. Darnel, J.Lodish, Hand Baltimore, D. (1991) Cell and molecular biology. Lea and Fibiger, Washington.
20. De Robertis, E.D.P and Robertis, E.M.P (1991) Cell and molecular biology Scientific American books.
21. Dobzhansky, B (1961) Genetic and origin of species, Columbia university Press New York
22. Durbin (2007) Biological Sequence Analysis. Cambridge University Press India Pvt. Ltd
23. Gerald Karp (1985) Cell biology, Mc Graw Hill company..
24. Lewin, B, (1994) Genes, Oxford University Press, New York.
25. Lewis, W.H (1980) Polyploidy. Plenum Press, New York.
26. Nicholl T (2007) An Introduction to Genetic Engineering, Cambridge University Press India Pvt. Ltd
27. Roy S.C. and Kalayan kumar De (1997) Cell biology. New central Boos Calcutta
28. Sandhya Mitra,(1998) Elements of molecular biology. Macmillan, India Ltd.

29. Sharma JR (1994) Principles and Practices of Plant Breeding. Tata McGraw-Hill Pub. Co. New Delhi
30. Sharma, A.K and Sharma A (1980) Chromosome technique Theory and practice, Aditya Books, New York
31. Swanson, C.P (1957) Cytology and Genetics. Englewood cliffs, NewYork.
32. Taylor (2008) Biological Sciences. Cambridge University Press India Pvt. Ltd
33. Twymann, R.M. (1998) Advanced molecular biology Viva books New Delhi.
34. Veer Bala Rastogi (2008), Fundamentals of Molecular Biology Ane Books Pvt. Ltd
35. A. J. Nair . Basics of Biotechnology- Laxmi Publications, New Delhi.
36. S S Purohit and S K Mathur; Biotechnology-Fundamentals and Application- Agrobotanica, India.
37. A. J. Nair Introduction to Genetic Engineering & Biotechnology.Jones & Bartlett Publishers, Boston,USA.
38. H S Chawla Introduction to Plant Biotechnology-; Oxford & IBH publishing Co.Pvt.Ltd., New Delhi.
39. H D Kumar Modern concept of Biotechnology, Vikas Publishing House, Pvt. Ltd., New Delhi.
40. P C Trivedi ,Plant biotechnology, Recent Advances Panima Publishing Corporation, New Delhi.
41. Du, C., and S. A. Jackson. 2019. Machine learning and complex biological data. Genome Biology 20: 76. https://doi.org/10.1186/s13059- 019- 1689- 0
42. Alexis and Mathew Leon.,Fundamentals of Information Technology Leon Vikas
43. Plant R. E., Stone N. D. (1991). Knowledge-based systems in agriculture. McGraw-Hill, Inc. 1221 Avenue of the Americas, New York, NY 10020.
44. Han S., Steward B.L., Tang L. (2016). Intelligent agricultural machinery and field robots. In Zhang Q. Precision agriculture technology for crop farming (pp.133-176). CRC Press, Taylor&Francis Group, New York.
45. Lucci S., Kopec D. (2013). Artificial intelligence in the 21st century. 22841 Quicksilver Drive Dulles, VA 20166.
46. V.Rajaraman Introduction to Information Technology,., Prentice Hll.
47. Ramesh Bangia Learning Computer Fundamentals., Khanna Book Publishers
48. Bass, Joel,E and et. al., Allyn & Bacon, 2009 .Methods for Teaching Science as Inquiry, The truth of science, Newton R.G

Suggested Continuous Internal Evaluation(CIE) methods

Total marks: 25

One Test/Assignments (hand written or typed 500 -1500 words)/Quizzes/ Presentation etc.(as decided by the teacher) carrying Maximum Marks 20 and a Viva-Voce/Class interaction of 5 marks.

Suggested equivalent online courses:

https://www.cytology-iac.org/educational-resources/virtual-slide-library
https://www.asct.com/ASCTWeb/Content/Cytopreparation_Online_Course.aspx
https://www.mooc-list.com/tags/genetics
https://www.coursera.org/learn/genetics-evolution
https://www.my-mooc.com/en/mooc/introduction-to-genetics-and-evolution/

Programme/Class: Degree	Year: III	Semester: VI Paper-II
Subject: Botany		
Course Code: BOTB602T	**Course Title: Ecology & Environment**	

Course outcomes:

1. acquaint the students with complex interrelationship between organisms and environment;
2. make them understand methods for studying vegetation, community patterns and processes, ecosystem functions, and principles of phytogeography.
3. This knowledge is critical in evolving strategies for sustainable natural resource management and biodiversity conservation.

Credits: **4**	**Core Compulsory/Elective**
Max. Marks **CIE: 25** Max. Marks **End Semester Examination:75** **Total Max. Marks: 100**	Min.Passing Marks **CIE:09** Min. Passing Marks **End Semester Examination: 26** **Total Min. Passing Marks: 35**

Total No. of Lectures-Tutorials-Practical (in hours per week): **4-0-0**

Unit	Topic	No. of Lectures (60 hrs)
I	**Natural resources & Sustainable utilization**: Land Utilization, Soil degradation and management strategies; Restoration of degraded lands. Water , Wetlands; Threats and management strategies, Ramsar sites ,Forests: Major and minor forest products; Depletion, Biological Invasion, Energy: Renewable and non-renewable sources of energy , Contemporary practices in resource management : EIA, GIS, Participatory Resource Appraisal, Ecological Footprint with emphasis on carbon footprint, Resource Accounting.	**7**
II	**Ecology & Ecosystem** Definition of Ecology, Ecological Factors, Positive and negative interactions. Ecosystem – Concept of an ecosystem-structure and function of an ecosystem. Abiotic and biotic com-Energy flow in an ecosystem Ecological Succession-Definition & types. Processes and types (autogenic, allogenic, autotrophic, heterotrophic, primary & secondary), Hydrosere and Xerosere. Food chains and food webs, Ecological pyramids, production and productivity; And components. Types of ecosystems: Forest Ecosystem, Grassland, Crop land, aquatic Ecosystems Ecological Adaptations – Hydrophytes, Xerophytes, Halophytes, Epiphytes and Parasites.	**8**
III	**Soil Formation, Properties & Conservation** Soil: Origin, Formation, composition, Soil types, Soil Profile, Soil Microorganisms, soil processes, Soil Erosion, Biogeochemical cycles, Soil Conservation: Biological– Contour farming, Mulching, Strip cropping, Terracing and Crop rotation. Mechanical–Basin Listing, Construction of dams, Watershed Management, Soil reclamation	**7**
IV	**Biodiversity and its conservation:** Definition -genetic, species, and ecosystem diversity. Value of biodiversity: social, ethical, aesthetic and option values; hotspots of Biodiversity threats to biodiversity, Biotic communities and populations, their characteristics and dynamics. Endemic and endangered species of plants in India. Ecological niche, ecotypes, ecological indicators. *Conservation of Biodiversity:* Ex-situ and in-situ conservation, Red data book, botanical gardens, National park, Sanctuaries, hot & hottest spots and Bioreserves. Role of Seed Bank and Gene Bank Valuing plant resources, ecotourism, Role of NBPGR, FAO, BSI.	**7**
V	**Phytogeography:** Biogeographic regions of India & world, Agroecological & Floristic zones of India. Natural vegetation of India, static and dynamic plant geography, basic principles governing geographical distribution of plants, Phytogeographical regions of India, Vegetational types in Uttar Pradesh.	**7**

VI	**Environmental audit & Sustainability** Concept of environmental audit; Guidelines of environmental audit; Methodologies adopted along with some industrial case studies; Environmental standards: ISO 14000 series; Scheme of labelling of environment friendly products (Ecomark); Life cycle analysis; Concept of energy and green audit, Strategies and debates on sustainable development; Concept of Sustainable Agriculture; India's environment action programme: issues, approaches and initiatives towards Sustainability; Sustainable development in practice.	**8**
VII	**Pollution, Waste management & Circular Economy** Environmental pollution, Environmental protection laws, Bioremediation, Activated Sludge Process (ASP) – Trickling Filters – oxidation ponds, fluidized bed reactors, membrane bioreactor, neutralization, ETP sludge management; digesters, up flow anaerobic sludge blanket reactor, fixed film reactors, sequencing batch reactors, hybrid reactors, bioscrubbers, biotrickling filters; regulatory framework for pollution monitoring and control; case study: Ganga Action Plan; Yamuna Action Plan; implementation of CNG ;Waste- Types , collection and disposal, Recycling of solid wastes (hazardous & non-hazardous) - classification, collection and segregation , Incineration, Pyrolysis and gasification , Sanitary landfilling ; composting, Biogas production ,Circular Economy & sustainability.	**8**
VIII	**Environmental ethics, Carbon Credits & Role of GIS** Carbon credit: concept, exchange of carbon credits. Carbon sequestration, importance, meaning and ways. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Wasteland reclamation. Consumerism and waste products. Clean development mechanism. Geographical Information Systems: definitions and components; spatial and non-spatial data; GIS software packages; GPS survey, data import, processing, and mapping. Applications and case studies of remote sensing and GIS in land use planning, forest resources & agriculture studies.	**8**

Suggested Readings:

1. Chapman and Riss. Ecology: Principles and Applications, Latest Ed., Cambridge University Press
2. Shukla, R.S. & Chandel, P.S. Plant Ecology, Latest Ed., S. Chandel and Co.
3. Kumar, H.D. Modern Concept of Ecology, Latest Ed. Vikas Publishing House
4. Begon, M., Herper, J.L. and Townsend, C.R. Ecology- Individuals, Populations and Communities (3rd ed.), Oxford Blackwell Science
5. Verma, P.S. & Agarwal, U.K. Concept of Ecology, Latest Ed., S. Chand & Company
6. Odum, F.P. Fundamentals of Ecology, Latest Ed., Saunders
7. Sharma, P.D. Elements of Ecology, Latest Ed., Rastogi Publications
8. Ambasht, R.S. & Ambasht, N.K. A Text Book of Plant Ecology, Latest Ed., CBS Publication & Distributors
9. Mani, M.S. Bio-Geography of India, Latest Ed., Springer-Verlag.
10. Mackenzie et al. Ecology, Latest Ed., Viva Books.
11. Gurevitch, J. (et al.)., The Ecology of plants, 2002, Sinauer Associates.
12. Kimar, U. & Asija, M.J. Bio-diversity: Principles & Conservation, 2005, Student Edition, Agrobios (India)
13. Krishnamurthy, K.V. An Advanced Text Book on Biodiversity, 2003, Oxford & IBH Publishing Co. Ltd.
14. Mitra, D., Guha, J.K., Chowdhury, S.K. Studies in Botany, Vol. II (7th ed.) Moulik Library.
15. Primack, R.B. Essentials of Conservation Biology, 1993, Sinauer Associates.
16. Lo, C.P. & Yeung, A.K.W. Concepts and Techniques of Geographic Information Systems, 2002, Printice-Hall of India.
17. Cain, Bowman, Hacker. Ecology. 2014. 3rd Ed. Sinauer Associates
18. Vasudevan, N. (2006). Essentials of Environmental Science. Narosa Publishing House, New Delhi.
19. Singh, J. S., Singh, S.P. and Gupta, S. (2006). Ecology, Environment and Resource Conservation. Anamaya Publications, New Delhi.
20. Rogers, P.P., Jalal, K.F. and Boyd, J.A. (2008). An Introduction to Sustainable Development. Prentice Hall of India Private Limited, New Delhi.
21. Abbasi, S. A. (1998). Environmental Pollution and its Control. Cogent International, Pondicherry.
22. Abbasi, S. A. and Ramasamy, E. V. (1999). Biotechnological Methods of Pollution Control. Universities Press (India) Limited, Hyderabad.
23. Peavy, H. S., Rowe, D. R. and Tchobanoglaus, G. (1985). Environmental Engineering, Mc Graw Hill Book Company, Singapore.

24. Rand, M. C., Greenberg, A. E. and Taras, M. J. (Ed.) (1995). Standard methods for the examination of water and wastewater: 19th edition, American Public Health association (APHA), Washington, D.C.
25. Scragg, A. (1999). Environmental Biotechnology, Addison Wesley Longman, Singapore.
26. Tchobanoglaus, G. (1988). Wastewater Engineering: Treatment, Disposal, Reuse. Tata Mc Graw Hill, New Delhi.
27. Aarve, V. P., William, A. W. and Debra, R. R. (2002). Solid waste engineering. Cengage reading, USA.
28. George, T., Hilary, T. and Samuel, A. V. (1993). Integrated solid Waste Management, Engineering Principles and Management Issues, Mc Graw Hills.
29. George, T. and Frank, K. (2002). Handbook of solid waste management: (Second edition). Mc Graw Hills.
30. Kanthi, L. S. (2000). Basics of Solids and hazardous waste management Technologies. Prentice Hall.
31. Anonymous. 1997. National Gene Bank: Indian Heritage on Plant Genetic Resources (Booklet). National Bureau of Plant Genetic Resources, New York.
32. Gillespie, A. 2006. Climate Change, Ozone Depletion and Air Pollution: Legal Commentaries
33. with Policy and Science Considerations. Martinus Nijhoff Publishers.
34. Hardy, J.T. 2003. Climate Change: Causes, Effects and Solutions. John Wiley & Sons.
35. Harvey, D. 2000. Climate and Global Climate Change. Prentice Hall.
36. Manahan, S.E. 2010. Environmental Chemistry. CRC Press, Taylor and Francis Group.
37. Maslin, M. 2014. Climate Change: A Very Short Introduction. Oxford Publications.
38. Mathez, E.A. 2009. Climate Change: The Science of Global Warming and our Energy Future.Columbia University Press.
39. Mitra, A.P., Sharma, S., Bhattacharya, S., Garg, A., Devotta, S. &Sen, K. 2004. Climate Change and India. Universities Press, India.

Suggested Continuous Internal Evaluation(CIE) methods

Total marks: 25

One Test/Assignments (hand written or typed 500 -1500 words)/Quizzes/ Presentation etc.(as decided by the teacher) carrying Maximum Marks 20 and a Viva-Voce/Class interaction of 5 marks.

Programme/Class: Degree	Year: III	Semester: VI Paper-III
Subject: Botany		
Course Code: BOTB603P	**Course Title: Lab on Cytogenetics, Conservation & Environment management**	

Course outcomes: After the completion of the course the students will be able:

1. To perform all experiments related to the semester-i.e. Plant tissue cultured plants, conducting breeding onfield, conserving and depolluting the environment.
2. Can be employed in environment impact assessment companies & start his own venture

Credits: **2**	**Core Compulsory**
Max. Marks **CIE: 25** Max. Marks **End Semester Examination: 75** **Total Max. Marks: 100**	Min.Passing Marks **CIE: 09** Min. Passing Marks **End Semester Examination: 26** **Total Min. Passing Marks: 35**

Total No. of Lectures-Tutorials-Practical (in hours per week): **0-0-2**

Unit	Suggested lab/virtual experiment (Perform minimum any three experiments from each unit)	No. of Lectures (60hrs)
I	**Cell biology** 1. Study of plant cell structure with the help of epidermal peal mount of Onion/Rhoeo/Crinum 2. Measurement of cell size by the technique of micrometry. 3. Counting cells per unit volume with the help of haemocytometer (Yeast/pollen grains) 4. Determination of mitotic index and frequency of different mitotic stagesin pre-fixed root tips of *Allium cepa*.	**7**
II	**Genetics** 1. Monohybrid cross (Dominance and incomplete dominance) 2. Dihybrid cross (Dominance and incomplete dominance) 3. Gene interactions (All types of gene interactions mentioned in the syllabus) a. Recessive epistasis 9: 3: 1. b. Dominant epistasis 12: 3: I c. Complementary genes 9: 7 d. Duplicate genes with cumulative effect 9: 6: 1 e. Inhibitory genes 13: 3 4. Observe the genetic variations among inter and intra specific plants. 5.Demonstration of Breeding techniques-Hybridization, case studies of mutation, polyploidy, emasculation experiment.	**8**
III	**Biostatistics:** 1. Univariate analysis of statistical data: Statistical tables, mean, mode, median, standard deviation and standard error (using seedling population / leaflet size). 2. Calculation of correlation coefficient values and finding out the probability. 3.Determination of goodness of fit in Mendellian and modified mono-and dihybrid ratios (3:1, 1:1, 9:3:3:1, 1:1:1:1, 9:7, 13:3, 15:1) by Chi-square analysis and comment on the nature of inheritance. 3. Computer application in biostatistics - MS Excel and SPSS	**7**

IV	**Plant tissue culture** 1. Familiarization of instruments and special equipments used in the planttissue culture experiments 2. Preparation of plant tissue culture medium, and sterilization, Preparation ofstock solutions of nutrients for MS Media. 3. Surface sterilization of plant materials for inoculation (implantation in the medium) 4. Micropropagation of potato/tomato/ - Demonstration 5. Protoplast isolation and culturing – Demonstration	**8**
V	**Ecology & Environment** 1. Ecological Adaptations: Hydrophytes, Xerophytes, Halophytes, Epiphytes and Parasites 2. Study of morphological adaptations of hydrophytes and xerophytes(four each). 3. Study of biotic interactions of: Stem parasite (Cuscuta), Root parasite (Orobanche) Epiphytes, Predation (Insectivorous plants). 4. Observation and study of different ecosystems mentioned in the syllabus. 5. Field visit to familiarize students with ecology of different sites	**8**
VI	**Soil Formation, Properties & Conservation** 1. Determination of pH of various soil and water samples (pH meter, universal indicator/Lovibond comparator and pH paper) 2. Analysis for carbonates, chlorides, nitrates, sulphates, organic matterand base deficiency from two soil samples by rapid field tests. 3. Determination of organic matter of different soil samples by Walkley& Black rapid titration method. 4. Soil Profile study 5. Soil types of India-Map	**8**
VII	**Biodiversity and Phytogeography:** 1. Study of community structure by quadrat method and determination of (i) Minimal size of the quadrat, (ii) Frequency, density and abundance of components (to be done during excursion/field visit). 2. Marking of vegetation types of India, World & Uttar Pradesh on maps	**7**
	3. Phytogeographical areas of India	
VIII	Pollution &Waste management 1. Study of instruments used to measure microclimatic variables: Soil thermometer, maximum and minimum thermometer, anemometer, psychrometer/hygrometer, rain gauge and lux meter 2. Estimation of chloride and dissolved oxygen content in water sample 3. Comparative anatomical studies of leaves form polluted and less polluted areas. 4. Measurement of dissolved O2 by azide modification of Winkler's method. 5. Determination of dissolved oxygen of water samples from polluted and unpolluted sources. 6. Microbiological assessment of drinking water using MPN technique- waterfrom well, river, water supply department and packaged drinking water 7. Making kitchen waste from compost/vermicompost by Enzymes/Bio decomposer/ Whey with dung. **Climate Change, Carbon Credits & Role of GIS** 1. Conducting Waste Audit of your Institution -Demo 2. Green auditing of the College/University -Demo	**7**

Suggested Readings: as in papers above:

1. Practical Botany (Part III) Author: Sunil D Purohit, Anamika Singhvi & Kiran Tak 2013 Apex Publishing House,Raj.
2. Practical Botany (Part II) Author: N. C. Aery, Sunil D Purohit & Gotam K Kukda 2013 Apex Publishing House,Raj.
3. A Handbook Of Soil, Fertilizer And Manure (2nd Ed.) (pb) ISBN : 9788177544152Edition : 02Year : 2017Author : Gupta PKPublisher : Agrobios (India)
4. Green Technology: An Approach For Sustainable Environment ISBN : 9788177543438Edition :01Year : 2021Author : Dr. Purohit SSPublisher : Agrobios (India)
5. Laboratory Manual Of Chemical And Bacterial Analysis Of Water And SewageISBN : 9788177540802Edition : 01Year : 2011Author : Theroux FR , Eldridge EF , Mallmann WLPublisher : Agrobios (India)
6. Methods In Environmental Analysis: Water Soil And Air (2nd Ed.) ISBN : 9788177543087Edition : 02Year : 2021Author : Gupta PKPublisher : Agrobios (India)
7. Water Treatment And Purification Technology ISBN : 9788177540024Edition : 01Year : 2009Author : Ryan WJPublisher : Agrobios (India

http://vidyamitra.inflibnet.ac.in/index.php/home/subjects?domain=Life+Science&subdomain=Botany
http://heecontent.upsdc.gov.in/Home.aspx
(http://epathshala.nic.in/, http://epathshala.gov.in/)

Suggested equivalent online courses:
https://www.cytology-iac.org/educational-resources/virtual-slide-library
https://www.asct.com/ASCTWeb/Content/Cytopreparation_Online_Course.aspx
https://www.mooc-list.com/tags/genetics
https://www.coursera.org/learn/genetics-evolution
https://www.my-mooc.com/en/mooc/introduction-to-genetics-and-evolution/

Suggested Continuous Internal Evaluation(CIE)methods

Total marks: 25

One Practical Tests/Record/Chart/Model carrying Maximum Marks 20 and a Viva-Voce/Practical Class Interaction as decided by the concerned teacher/HOD) of 5 marks.

B.A. (YOGA)

Eligibility	:-	H.S.C...or Its Equivalent OR 10+ two years Govt. recognized full time course OR 11(old SSC) + 1 year Govt. recognized full time course With working knowledge of Hindi/English
Age	:-	17 to 60 Years (Physically fit)
Note	:-	The students should produce Medical Fitness Certificate at the time of admission.
Medium	:-	Hindi, English
Duration	:-	Three academic Years (June to March every year) six semesters
Numbers of COURSEs		:- 5+ Practical COURSE each semester
Total Marks :-		3000

NOTE: Elective Paper - Paper V in Sem – IV, Sem - V & Sem – VI is elective paper. TheStudent can opt any one from the subjects offered as paper V.

SEMESTER I

1.	COURSE I - Sanskrit (Foundation.) I	
2.	COURSE II -History and Philosophy of Yoga I	
3.	COURSE III -Schools of Yoga I	
4.	COURSE IV- Yoga Practical I	
5.	COURSE V -Educational Principles& Practices of Yoga I	

SEMESTER II

1.	COURSE I - Sanskrit (Foundation.) II	
2.	COURSE II -History and Philosophy of Yoga II	
3.	COURSE III -Schools of Yoga II	
4.	COURSE IV- Yoga Practical II	
5.	COURSE V -Educational Principles& Practices of Yoga II	

SEMESTER III

1.	COURSE I - Sanskirt III	
2.	COURSE II -Philosophy of Yogashastra I	
3.	COURSE III -Yoga Therapy I	
4.	COURSE IV- Yoga Practical III	
5.	COURSE V -Anatomy and Physiology	

SEMESTER IV

1. COURSE I - Sanskirt IV — स्नडेकृतम्- II
2. COURSE II -Philosophy of Yogashastra II — योगलडेवज्ञानम्
3. COURSE III -Yoga Therapy II — योगपचार–पद्धति
4. COURSE IV- Yoga Practical IV — योगप्राटेयषिकम्
5. COURSE V - **Elective Papers**

Elective – I	Advanced Yoga - Anatomy and Physiology शरीररचना–कार्यशाडेत्रम्
Elective – II	Yoga (For Non Yoga Students)
Elective – III	Social Sciences
Elective – IV	Jyotisha
Elective – V	Education
Elective – VI	Arham Yoga

SEMESTER V

1. COURSE I - Sanskrit V — स्नडेकृतम्- III
2. COURSE II -Philosophy of Yogashastra-III — योगलाडेवज्ञानम्– I
3. COURSE III -Applied Yoga-I — योगप्रयोग
4. COURSE IV- Yoga Practical-V — योगप्राटेयषिकम्
5. COURSE V - **Elective Papers**

Elective – I	Advanced Yoga -Yoga and Positive Health योगतथा अनामुल–डेवाडेथ्यम्
Elective – II	Yoga (For Non Yoga Students)
Elective – III	Social Sciences
Elective – IV	Jyotisha
Elective – V	Education
Elective – VI	Arham Yoga

SEMESTER VI

1. COURSE I - Sanskrit VI — स्नडेकृतम्- III
2. COURSE II -Philosophy of Yogashastra-IV — योगलाडेवज्ञानम्– I
3. COURSE III -Applied Yoga-II — योगप्रयोग
4. COURSE IV- Yoga Practical-VI — योगप्राटेयषिकम्
5. COURSE V - **Elective Papers**

Elective – I	Advanced Yoga -Yoga and Positive Health योगतथा अनामुल–डेवाडेथ्यम्
Elective – II	Yoga (For Non Yoga Students)
Elective – III	Social Sciences
Elective – IV	Jyotisha
Elective – V	Education
Elective – VI	Arham Yoga

COURSE – I	SANSKRIT (FOUNDATION)-I	संस्कृत- I	100 MARKS

Module-I **Nitishatakam (First five paddhati)** **50 Marks**

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Module-I □□□□□□□□□□□□□. **25 Marks**

Abhyasapustakam

Internal Assessment - **25 marks**

Assignment – 10 Marks

Attendace – 05 Marks

Library Work – 05 Marks

Class Interaction – 05 Marks

Reference Books :

नीतिशतकम – चौखंबा प्रकाशन, वाराणसी

नीतिशतकम – डा. राजेश्वर मिश्र, अक्षयवट प्रकाशन 26 बलरामपुर हाउस, इलाहाबाद–211002

नीतिशतकम – मराठी अनुवादासह) प्राचार्य वेदकुमार वेदालंकार, प. विनायकेश्वर महाराज, विद्याभारती प्रकाशनलातूर. नीतिशतकम – मराठी

अनुवादासह) डा. हेमा गोखले. क.का.संस्कृत विश्वविद्यालय प्रकाशन, रामटेक

नीतिशतकम – विद्याभारती केंद्र सीताबर्डी नागपूर

अभ्यासपुस्तकम – डा. एच. आर. विश्वास, संस्कृतभारती प्रकाशनअक्षरम, बेंगूर

COURSE – II	HISTORY AND PHILOSOPHY OF YOGASHASTRA – I योगाचेइतिहास तत्वज्ञानम	100 MARKS

Module-I Definition of Yoga **40 Marks**
Misconceptions about YogaHistory
of Yoga Tradition

Module-II AshtangaYoga- **35 Marks**
Yama(2-29) Niyamas(2-30)-ethical/moral dimension,
Asanas(2-31&46),Pranayama(2-49),Pratyahara(2-54),Dharana(3-01),Dhyana(3-02),Samadhi(3-03).

Internal Assessment - **25 marks**

Assignment – 10 Marks

Attendace – 05 Marks

Library Work – 05 Marks

Class Interaction – 05 Marks

Reference Books :

1.	योगप्रक्रियांचे मार्गदर्शन	–	डा.एम.एल. घोटे	
2.	पातंजल योगदर्शन	–	डा. नाडिकर/शंकर	श्री.हरियाणा,अमरावती
3.	योग हिंदूंच्या दृष्टी	–	डा. अरुण खोडस्कर,हिंद महाराष्ट्र योग परिषद, अमरावती	
4.	भारतीय मानसशास्त्र आणि योगशास्त्र–		श्री.कोल्हटकर, प्रसाद प्रकाशन पुणे	

COURSE – III	**SCHOOLS OF YOGA – I** योगसंप्रदाय	**100 MARKS**

Module-I **Comparative Study of following Schools of Yoga:** **60 Marks**

1.	Bhakti Yoga	-	with reference to Narada Bhakti Sutra	12 Marks
2.	Karma Yoga	-	with reference to Bhagvad Geeta	12 Marks
3.	Jnana Yoga	-	with reference to Upanishads	12 Marks
4.	Raja Yoga	-	with reference to Patanjali Yoga Sutra	12 Marks
5.	Hatha Yoga	-	with reference to Hatha Yoga Pradipika	12 Marks

Module-II Integral Yoga of Aurobindo **15 Marks**

Internal Assessment - **25 marks**

Assignment – 10 Marks

Attendance – 05 Marks

Library Work – 05 Marks

Class Interaction – 05 Marks

Reference Books :

1. योग के सिद्धांत एवं अभ्यास – डॉ. कालिदास जोशी, डॉ. गणेश शंकर, सागर विश्वविद्यालय, सागर म.प्र.
2. भक्तियोग – स्वामी विवेकानंद, रामकृष्ण मठ, धंतोली, नागपुर
3. कर्मयोग – रामकृष्ण मठ, धंतोली, नागपुर
5. ज्ञानयोग – रामकृष्ण मठ, धंतोली, नागपुर
6. योग: ईश्वरेच्छा कुंजी – श्री अरुण खाडेकर, अमरावती

COURSE – IV **YOGA PRACTICALS** **100 MARKS**

Practicals - 50 Marks **Viva - 25 Marks**

Internal Assessment **25 marks**

Assignment – 10 Marks

Attendance – 05 Marks

Library Work – 05 Marks

Class Interaction – 05 Marks

The following practices will be taught:-

1. Sukshma Vyayama -

1. Kapola Shakti Vikasaka
2. Karna Shakti Vardhaka
3. Greeva Shakti Vikasaka
4. Karatala Shakti Vikasaka
5. Manibandha Shakti Vikasaka
6. Purna Bhuja Shakti Vikasaka
7. Vakshasthala- Shakti Vikasaka
8. Jangha-shakti vikasaka

2. Loosening Exercises -

1. Twisting
2. Side Bending
3. Forward-backward bending
4. Twisting and bending

3. Breathing Exercises -

1. Hands in and out breathing
2. Tadasan-shavasan
3. Rabbit-breathing
4. Shwan-shwasana
5. Shashankasana-shwasana

4. Asanas (Cultural Asanas)

A. Standing:-

1. Ardha-katichakrasana
2. Padahastasana
3. Ardha-chakrasana
4. Trikonasanaa
5. Parivrutta-Trikonasana

B. Sitting-Position:-

1. Paschimottanasana
2. Ushtrassana
3. Vakrasana
4. Ardhamatsyendrasana
5. Shashankasana
6. Suptavajrasana

C. Relaxative Asanas :-

1. Shavasana
2. Makarasana

D. Meditative Asanas :-

1. Padmasana
2. Vajrasana
3. Swastikasana
4. Siddhasana
5. Sukhasana

Reference Books

1. Encyclopaedia of Yoga (No. 410) - Dr. Ramkumar Rai, Chowkhamba Sanskrit Sansthan, P.O.No: 1008, Varanasi
2. Introduction to the Yoga Philosophy - S.C. Vasu

		Chowkhamba Sanskrit Sansthan P.O.No: 1008, Varanasi
3. Yoga explained (No. 435)	-	Bengal Lancer Chowkhamba Sanskrit Sansthan P.O.No: 1008, Varanasi
4. Yoga Philosophy in relation to other Systems of Indian Thought (No. 447)	-	S.N. Dasgupta Chowkhamba Sanskrit Sansthan P.O.No: 1008, Varanasi

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COURSE - V EDUCATIONAL PRINCIPLES AND PRACTICES OF YOGA **100 MARKS**

योगाध्यापनपद्धतिः

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1. Lesson Planning and Class Management — 40 Marks
   Handling of Classes, direction, guidance, suggestions, counselling
2. Method of introducing and correcting Yoga Practices — 35 Marks

Internal Assessment - **25 marks**

Assignment –	10 Marks	Library Work – 05 Marks	
Attendance –	05 Marks	Class Interaction – 05 Marks	

Reference Book;

1. Teaching Methods in Yoga — Dr. M.L. Gharote & Dr. S.K. Ganguli, Kaivalyadham, Lonavala.

SEMESTER II

COURSE - I **SANSKRIT (FOUNDATION)-II** संस्कृतम्- I **100 MARKS**

Module-I **Nitishatakam (Next five paddhati)** **50 Marks**

(सुजन-पद्धती, परोपकार-पद्धती, धैर्य-पद्धती, दैव-पद्धती, कर्म-पद्धती)

Module-II **Aparikshitakarakam** **25 Marks**

Internal Assessment **25 marks**

Assignment – 10 Marks — Library Work – 05 Marks

Attendance – 05 Marks — Class Interaction – 05 Marks

Reference Books :

नीतिशतकम् – चौखम्बा प्रकाशन, वाराणसी

नीतिशतकम् – डॉ. राजेश्वर मिश्र, अक्षयवट प्रकाशन, 26, बलरामपुर हाउस, इलाहाबाद–211002

नीतिशतकम् – (मराठी अनुवादासह) प्राचार्य वेदकुमार वेदालंकार, प. सिद्धेश्वर महाराज, विद्यावर्ती प्रकाशन, लातूर. नीतिशतकम् – (मराठी अनुवादासह) डॉ. हेमा गावडे, कविकुलगुरु कालिदास संस्कृत विश्वविद्यालय प्रकाशन, रामटेक

नीतिशतकम् – विद्याप्रसार केंद्र, सीताबर्डी, नागपुर

अपरीक्षितकारकम् – चौखम्बा प्रकाशन, वाराणसी

COURSE – II **HISTORY AND PHILOSOPHY OF YOGASHASTRA – II** **100 MARKS**

योगशास्त्रइतिहास तर्कविज्ञानम

Module-I **Yoga as a Darshana, its place and status among other Darshanas** **25 Marks**

Patanjali as a 'Sutrakara'
Patanjali's time
Nature and structure of Patanjal Yoga.

Module-II **Samkhya metaphysics as the basis of Yoga Sutras.** **50 Marks**

Nirishwara Samkhya and its Dualism,Concept of Ishwara in Yoga Sutras.
Pranava and its Significance
Cittavrttis and Cittavikshepas,Citta prasadana.

Internal Assessment **25 marks**

Assignment – 10 Marks,
Attendance – 05 Marks,
Library Work – 05 Marks
Class Interaction – 05 Marks

Reference Books :

1º योगप्रक्रियाने मार्गदर्शन — डॉ.एम.एल. घरोटे
2 पातंजल योगदर्शन — डॉ. गाविकारोळकर श्रीहर्ष प्रकाशन अमरावती
3 योग ईशईश्य कुंजी — डॉ. अरुण खोडस्तकर हनुमान व्यायाम प्रसारक मंडळ, अमरावती
4 भारतीय मानसशास्त्र आणि योगशास्त्र — श्री.कोल्हटकर, प्रसाद प्रकाशन पुणे

COURSE – III **SCHOOLS OF YOGA – II** **100 MARKS**

योगसम्प्रदाय

Module-I Other Schools of Yoga **40 Marks**

Prana-samyama Yoga,
Kundalini Yoga, Mantra Yoga,
Laya Yoga,
Shaktipata Yoga.

Module-II **35 Marks**

Study of different meditation techniques with reference to theirMetaphysical foundations.
Patanjala Yoga MeditationZen Meditation
Dynamic Meditation
Vipassana
Bhavatitadhyana
Prekshadhyan

Internal Assessment **25 marks**

Assignment – 10 Marks
Attendace – 05 Marks
Library Work – 05 Marks
Class Interaction – 05 Marks

Reference Books :

1º त्वहं ज्मीदपुनमे — वलए डण्एण ब्लीतवजमए स्वदकवदण
2º योगा के सिध्दांत एवं अभ्यास — डॉ.कालिदास जोशी, डॉ.गणेश शंकर सागर विद्यापीठ, सागर (म.प्र.)
3º भक्तियोग — रामकृष्ण मठ, धंतोली, नागपूर
4º कर्मयोग स्वामी विवेकानंद — रामकृष्ण मठ, धंतोली, नागपूर
5º ज्ञानयोग — रामकृष्ण मठ, धंतोली, नागपूर
6º योग, ईश्वरईश्य कुंजी — पंडित हरीकृष्ण शर्मा दातार पिर्क्ष सर्वाल प्रकाशन करंट बुक एजन्सी, वाराणसी –5

COURSE – IV	YOGA PRACTICALS – II	100 MARKS
Practicals	50 Marks	
Viva	25 Marks	
Internal Assessment	25 marks	

Assignment – 10 Marks
Attendance – 05 Marks
Library Work – 05 Marks
Class Interaction – 05 Marks

The following practices will be taught:-

1. **Suryanamaskara –**
   1. Should be practised as Physiological, Psychological and Spiritual practice.
   2. 12 repetitions with the chanting of mantras.
2. **Asanas (Cultural Asanas)**

A. Prone on position:-
   1. Bhujangasana 2. Ardhshalabhasana 3. Shalabhasan
   4. Dhanurasana

B. Supine position :-
   1. Viparitakarani 2. Sarvangasana 3. Matsyasana
   4. Halasana
   5. Shirshasana

3. **PRANAYAMA :-**
   1. Sectional Breathing : 2. Suryabhedan Pranyam
   3. Chandrabhedan Pranayam 4. Nadishodhan Pranayam
   5. Shitali Pranayam 6. Sitkari Pranayam
   7. Bhramari Pranayam 8. Bhastrika Pranayama

4. **KRIYAS :-**
   1. Kapalabhati 2. Jalaneti 3.Sutraneti
   4. Vamandhauti 5. Dandaneti 6. Trataka

5. **MEDITATION** :- (Different techniques such as)
   1. Omkar Japa 2. Sakshibhava 3. Breath- Awareness

Reference Books

1. Encyclopaedia of Yoga (No. 410) - Dr. Ramkumar Rai
   Chowkhamba Sanskrit SansthanP.O.No: 1008, Varanasi
2. Introduction to the Yoga Philosophy - S.C. Vasu
   Chowkhamba Sanskrit SansthanP.O.No: 1008, Varanasi
3. Yoga explained (No. 435) - Bengal Lancer
   Chowkhamba Sanskrit SansthanP.O.No: 1008, Varanasi
4. Yoga Philosophy in relation to other Systems of Indian Thought (No. 447) - S.N. Dasgupta
   Chowkhamba Sanskrit Sansthan P.O.No: 1008, Varanasi

COURSE – V	EDUCATIONAL PRINCIPLES AND PRACTICES OF YOGA – II	100 MARKS

योगाध्यापनपद्धति

Module-I Method of teaching Yoga to different age groups (Men and Women) **40 Marks**

Age	12-20 :	20-30:	30-40	40-50:
	50-60:	60-70:	70 above	

Module-II Classification and importance of Methods, Teaching aids **35 Marks**

1. Classification of Teaching Methods
2. Importance of Teaching Methods
3. Teaching Aids in Yoga

Internal Assessment **25 marks**

Assignment –	10 Marks	Library Work – 05 Marks	
Attendance –	05 Marks	Class Interaction – 05 Marks	

Reference Book;

1. Teaching Methods in Yoga — Dr. M.L. Gharote & Dr. S.K. Ganguli, Kaivalyadham, Lonavala.

SEMESTER – III

COURSE – I	SANSKRIT – II संस्कृतम्– II	100 MARKS

Module-I	**Kathopanishad (Valli I&II)**	**50 Marks**
Module-II	**Bhagavadgita (Ch-12)**	**25 Marks**

Internal Assessment **25 marks**

Assignment –	10 Marks	Library Work –	05 Marks
Attendance –	05 Marks	Class Interaction– 05 Marks	

Reference Books :

भगवद्गीता – गीताप्रेस, गोरखपुर

श्रीमद्भगवद्गीता – व्याख्याता: पं. श्रीकिशोर मिश्र, सम्पूर्णानन्द संस्कृत विश्वविद्यालय, वाराणसी-221002 संस्करण

भगवद्गीता – प द द योग प्रकाशक, एम डी ... 201, ... डोंबिवली–421202 कठोपनिषद – गीताप्रेस, गोरखपुर

कठोपनिषद – व्याख्याता स्वामी ... संस्कृत ... संस्कृत संस्थान, वाराणसी कठोपनिषद –

... स्वामी ... योग संस्थान, दिल्ली

कठोपनिषद – आनंदवन ... संस्थान, मुंबई

COURSE – II	PHILOSOPHY OF YOGASHASTRA – I	योगदर्शनम्	100Marks

Module-I	Six Systems of Indian Philosophy- (Three Astika Darshan - Samkhya, Yoga and Poorva Meemaamsaa)	**30 Marks**
Module-II	Patanjala Yoga Sutras (Samadhi pada first 25 sutra)	**15 Marks**
Module-III	Hatha Yoga Pradipika (First Chapter)	**30 Marks**

Internal Assessment **25 marks**

Assignment –	10 Marks	Library Work –	05 Marks
Attendance –	05 Marks	Class Interaction	– 05 Marks

Reference Books

1. Bharatiya tattwajnan — Shri.Srinivasa Dikshit, Any Popular Book Stall
2. Encyclopaedia of Yoga (No. 410) — Dr. Ramkumar Rai

		Chowkhamba Sanskrit SansthanP.O.No: 1008, Varanasi
3.	Introduction to the Yoga Philosophy	S.C. Vasu Chowkhamba Sanskrit Sansthan P.O.No: 1008, Varanasi
4.	Yoga explained(No. 435)	Bengal Lancer Chowkhamba Sanskrit SansthanP.O.No: 1008, Varanasi
5.	Yoga Philosophy in relation to other Systems of Indian Thought	S.N. Dasgupta Chowkhamba Sanskrit Sansthan(No. 447) P.O.No: 1008, Varanasi
6.	Hathayoga Pradipika	Kaivalyadham, Lonavla
7.	Hathayoga Pradipika	Chowkhamba Sanskrit SansthanP.O.No: 1008, Varanasi

COURSE – III **YOGA THERAPY** योगोपचार–पद्धति **100 MARKS**

Module – I Principles of Yoga Therapy : 25 Marks
Meaning, Tools and Principles of Yoga therapy

Module – II Diseases related to Nervous system and Yoga treatment for them 25 Marks

Module – III Stress and its Management by Yoga 25 Marks

Internal Assessment **25 marks**

Assignment – 10 Marks Library Work – 05 Marks

Attendace – 05 Marks Class Interaction – 05 Marks

Reference Books

1. Physiology and Anatomy of Yogic Practices - Dr.M.M. Gore, Lonavala.
2. Yogic Therapy - Kuvalyananda and Dr. Vinekar
3. Structure and function of human body – Dr. Shrikrishna, Kaivalyadham, Lonawala.
4. शरीर विज्ञान आर योगाभ्यास हिन्दी –मराठी – डॉ.एम.एम. गोरे, लोनावला
5. शारीरिक रोगाच्या निवारणासाठी योग – कैवल्यधाम, लोणवला,पुणे

COURSE IV - **YOGA PRACTICAL** **100 MARKS**

Practical (Demonstration-50 Marks and Viva-voce- 25 Marks) **75 Marks**

Followiing Practices :-

Asanas:		Vrischikasana, Chakrasana, BAYurasana, Matsyendrasana
Pranayama	:	Bhastrika
Bandhas	:	Jalandhar Banda, Mula Bandha, Uddiyana Bandha
Mudras	:	Pranayama Mudras Mahamudra, Viparita Karani Mudra
Meditation	:	Pranav Sadhana, Nadanu Sadhana, Sakshibhava, Japa D
Practice of Yoga-Nidra		

Internal Assessment **25 marks**

Assignment – 10 Marks, Library Work – 05 Marks

Attendance – 05 Marks, Class Interaction – 05 Marks

Reference Books :

1. Hatha Yogapradipika (No. 465) - Choukhamba Sanskrit Series, Po. Box 1008, Varanasi 221001
2. Gheranda Samhita (No.415) - Ajay Kumar Gupta,Choukhamba Sanskrit Series Po. Box 1008, Varanasi 221001
   Hathapradipika - Kaivalyadham, lonavala,Mumbai, Choukhamba Sanskrit Series Po. Box 1008, Varanasi 221001
3. Ghaeranda Samhita - Kaivalyadham, lonavala,Mumbai, Choukhamba Sanskrit Series Po. Box 1008, Varanasi 221001

COURSE – V	INRODUCTION OF ANATOMY AND PHYSIOLOGY	100 MARKS
	शरीररचना–क्रियाविज्ञान–परिचय	

Module-I Basic Knowledge of Anatomy and Physiology — **25 Marks**

(Cells, Tissues, Organs, Systems)

Module-II Anatomy and Physiology of following Systems) — **50 Marks**

1. Skeletal system
2. Mascular system
3. Respiratory system
4. Circulatory system
5. Digestive system

Internal Assessment — **25 marks**

Assignment –	10 Marks,	Library Work –	05 Marks
Attendance –	05 Marks,	Class Interaction –	05 Marks

Reference books:

1.	Anatomy and Physiology in health and illness	--	Ross and Wilson
2-	क्रियाशारीर	–	डॉ. रणजीतराय गखले
3-	प्रत्यक्ष शारीरम्	–	एग.आठवले
4-	शरीर क्रिया	–	एग.आठवले
5.	Anatomy, Physiology of Yoga practices	--	Dr. Gore, Kaivalyadham, Lonawala.
6.	Structure and function of human body	--	Dr. Shrikrishna, Kaivalyadham, Lonawala.
7.	Yogic Therapy	--	Kuvalyananda and Dr. Vinekar
8.	शरीर विज्ञान आणि योगाभ्यास हिन्दी –मराठी	–	कैवल्यधाम, लोनावला

SEMESTER IV

COURSE – I	SANSKRIT – II	100 MARKS
	संस्कृतम्– II	

Module-I	**Bhagavadgita (Ch-2)**	**50 marks**
Module-II	**Shwetaketu-Aruni Katha** छान्दोग्योपनिषद् षष्ठ अध्याय प्रथम खण्ड	**15 Marks**
	Yajnavalkya-Maitryi Samvadk बृहदारण्यकोपनिषद् चतुर्थ अध्याय पंचम ब्राह्मण **10 Marks Internal**	

Assessment — **25 marks**

Assignment –	10 Marks,	Library Work –	05 Marks
Attendance –	05 Marks,	Class Interaction –	05 Marks

Reference Book :

भगवद्गीता – गीताप्रेस, गोरखपुर

श्रीमद्भगवद्गीता – व्याख्याता प. श्रीकिशोर मिश्र, सम्पूर्णानन्द संस्कृत विश्वविद्यालय, वाराणसी–221002 प्रकाशक

भगवद्गीता – प द वा जोग, प्रकाशक, एम डी प्लाग, 201 महाडेश्वर पूर्व रोड, डोंबिवली–421202

छान्दोग्योपनिषद – गीताप्रेस, गोरखपुर

छान्दोग्योपनिषद – सम्पादक, प. गणपति, प. महावीर प्रसाद, चौखम्बा विद्याभवन, वाराणसी–221001 छान्दोग्योपनिषद – सम्पादक, विद्वान गणपति कट्टी, श्रीशंकरनारायण अग्री, राष्ट्रियसंस्कृतविद्यापीठ, तिरुपति–28 बृहदारण्यक उपनिषद – गीताप्रेस, गोरखपुर

बृहदारण्यक उपनिषद – चौखम्बा प्रकाशन, वाराणसी

वैदिक कथा – डा. नन्द पुलिकका, सम्पूर्णानन्द संस्कृत विश्वविद्यालय प्रकाशन, वाराणसी

COURSE – II **PHILOSOPHY OF YOGASHASTRA** – II **100 Marks**

योगशास्त्रज्ञानम

Module-I Six Systems of Indian Philosophy- **25 Marks**
(Three Astika Darshan – Nyaya, Vaisheshika and Vedaanta)

Module-II Patanjala Yoga Sutras (Samadhipada) **25 Marks**
(from sutra 26 to the end of the first paada)

Module-III Hatha Yoga Pradipika (Second Chapter) **25 Marks**

Internal Assessment **25 marks**

Assignment – 10 Marks, Library Work – 05 Marks
Attendance – 05 Marks, Class Interaction – 05 Marks

Reference Books

1. Bharatiya tattwajnan — Shri.Srinivasa Dikshit, Any Popular Book Stall
2. Encyclopaedia of Yoga (No. 410) — Dr. Ramkumar Rai, Chowkhamba Sanskrit Sansthan, P.O.No: 1008, Varanasi
3. Introduction to the Yoga Philosophy — S.C. Vasu Chowkhamba Sanskrit Sansthan, P.O.No: 1008, Varanasi
4. Yoga explained(No. 435) — Bengal Lancer, Chowkhamba Sanskrit Sansthan, P.O.No: 1008, Varanasi
5. Yoga Philosophy in relation to other Systems of Indian Thought — S.N. Dasgupta, Chowkhamba Sanskrit Sansthan (No. 447)P.O.No: 1008, Varanasi
6. Hathayoga Pradipika — Kaivalyadham, Lonavla
7. Hathayoga Pradipika — Chowkhamba Sanskrit Sansthan

COURSE – III **YOGA THERAPY** – II योगोपचार–पद्धति **100 MARKS**

1) **Study of following psychosomatic ailments.** 75 Marks
Cardio Vascular ailments (Hyper-tension)
Respiratory ailments (Asthma, Nasal Allergy)
Diabetes, Obesity, Gastro intestinal disorders, Migraine, Headaches,
Arthritis, Women's problems , Children Mental Health

Internal Assessment **25 marks**

Assignment – 10 Marks, Library Work – 05 Marks
Attendance – 05 Marks, Class Interaction – 05 Marks

Reference Books

1. Anatomy &Physiology of Yogic Practices - Dr.M.M. Gore, Lonavala.
2. Yogic Therapy - Kuvalyananda and Dr. Vinekar
3. Structure and function of human body – Dr. Shrikrishna, Kaivalyadham, Lonawala.
4. शरीर विज्ञान और योगाभ्यास हिन्दी –मराठी – डॉ.म.म.गोरे, लोनवला
5. शारीरिक रोगाच्या निवारणार्थ योग – कैवल्यधाम, लोनावला,पुणे

COURSE IV - YOGA PRACTICAL 100 MARKS

A) Practical (Demonstration and Viva-voce) 75 Marks
Kriyas : Nauli, Basti, Danda Dhauti, Vastra-Dhauti, Shankha Prkshalana. 25 Marks

B) Five Lesson Plans 25 Marks

C) Course Report (Report of the Yoga Course conducted by the student) 25 Marks

Internal Assessment 25 marks

Assignment – 10 Marks, Library Work – 05 Marks
Attendance – 05 Marks, Class Interaction – 05 Marks

Reference Books :

1. Hatha Yogapradipika (No. 465) - Choukhamba Sanskrit Series, Po. Box 1008, Varanasi 221001
2. Gheranda Samhita (No.415) - Ajay Kumar Gupta,Choukhamba Sanskrit Series Po. Box 1008, Varanasi 221001
3. Hathapradipika - Kaivalyadham, lonavala,Mumbai, Choukhamba Sanskrit Series Po. Box 1008, Varanasi 221001

Course V - Elective Papers (any one of the following can be opted)

i) Advanced Yoga (For Yoga Students)
ii) Yoga (For Non Yoga Students)
iii) Social sciences
iv) Jyotisha
v) Education
VI) Arham Yoga

Elective – I (Advanced Yoga)

COURSE – V/* INTRODUCTION OF ANATOMY AND PHYSIOLOGY 100 MARKS

शरीररचना–कार्यशास्त्रपरिचय

Module-I Anatomy and Physiology of following systems 35 Marks
1.Excretary system
2.Nervous system
3.Endocrine system
4.Reproductive system
Module-II Shatkarma (Introduction and physiological significance) 20 Marks
Module-III Nadivijnana, Panchaprana, Panchakosha, 20 marks

Internal Assessment 25 marks

Assignment – 10 Marks, Library Work – 05 Marks
Attendance – 05 Marks, Class Interaction – 05 Marks

Reference books:

1. Anatomy and Physiology in health and illness -- Ross and Wilson
2. [illegible] – [illegible]
3. [illegible] – [illegible]

4- शरीर क्रिया — एग.आठवले

5. ।दंजवतलए धैलैपवसवहल वƒ स्वहं शतबजपबमे — तलए क्वलतमए इंपक्रंसतकीएए स्वदूसं

6. ˚जातनवजनतम दक मिदबजपवद वƒ निवंद इवकल — वाº†लिवतीदए इंपक्रंसतकीएए स्वदूसं

7. त्वहपब जैमतंचल — इंनवंसलददक दक वाº टपदमात

8. शरीर विज्ञान आर योगाभ्यास हिन्दी –मराठी — दममगर रवनवला

Elective – II

Yoga (For Non Yoga Students) – I

Course - V **BASIC PRINCIPLES OF YOGA** **100 marks**

Unit- I **25 Marks**

1. Yoga defination - Concepts, misconcepts, aims and objectives.
2. History & Philosophy of Yoga- Yoga Sutra, including 8 steps of Yoga (Ashtanga Yoga)

Unit- II

1. Introduction of Asanas, Pranayams, Mudras, Bandhas and Kriyas. **25 Marks**

Unit- III **25 Marks**

1. Difference between Yogic and non- yogic exercises.
2. Surya- Namaskar.

Internal Assessment **25 marks**

Assignment –	10 Marks,	Library Work –	05 Marks
Attendance –	05 Marks,	Class Interaction –	05 Marks

Reference Books-

1. शर पातजल यो — पच शेपा
2. यो व अयुवे — राजाकुश सै
1. Anatomy and physiology of Yogic Practice. — Makrand Gore Motilal Banarasidas, Jawahar Nagar, New Delhi7
2. Concept of Ayurveda for Perfect — H.S. kasture, health and Longevity,Chowkhamba Sanskrit Sansthan, P.O.Box 1008, Varanasi 221001.
3. The Yoga Sutra of Patanjali
4. The philosophy of Patanjali — harihar Swamy ,howkhamba Sanskrit Sansthan P.O.Box 1008, Varanasi 221001
5. पातंजल योगदर्शन तुलनात्मक अध्ययन — स्वामी सत्यानन्द योग, रामनगर, नागपुर।
6- योगदीपिका — बैंकं एस अयगर, योग इंस्टिट्यू, पुणे
7- सुर्यनमस्कार एक परिपूर्ण व्यायाम — स्वामी योगव्रती घार, राम नगर, नागपुर
8- योगदर्शन (व्याख्यासहित) हिंदी — स्वामी सत्यपति परिव्राजक दर्शन महाविद्यालय, गुजरात
9- आरोग्य सुक्तावली — डॉ अरूण खोडसकर,कृष्णदास, योग परिषद, लुप्त व्यायाम प्रसार संघ
10- योगसाधना कर्जा हिंदी — डॉ अरूण खोडसकर,कृष्णदास, योग परिषद, लुप्त व्यायाम प्रसार संघ
11- योगासन हिंदी — डॉ अनिल करवा अमित प्रकाशन, धंतोली , नागपुर

Elective – III

Social Science

Course - V	Social Sciences	100 marks
1.	Hitopadesh - Mitralabha	40 marks
2.	Bruhatsamhita -Vrukshayurveda	35 marks
3.	Internal Assessment	25 marks

Elective – IV

Jyotish

Course - V	iii) Jyotisha (Hora)	100 marks
Module- I	Chapter 1,2 & 6	25 marks
Module -II	Chapter 7,10 & 11	25 marks
Module- III	Chapter 13,14,15,16,17 & 18	25 marks
Module- IV	Internal Assessment	25 marks
Text-	**Bruhatjataka of Varaha Mihira**(RashiPrabheda,grahayoniPrabheda,Arishta, Ayurdaya,Karmajeeva,Rajayoga,Chandra yoga,Dwigrahayoga, RikshaShiladhyay,Chandra Rashi Shiladhyay,Rashishiladhyaya)	

Elective – V

Education

Course - V Education — 100 marks

EDUCATION FOR RURAL DEVELOPMENT

Objectives: **Marks: 75+25=100**

.1. To develop an understanding of the present status, issues and prospectus of education pertaining to rural areas.

2. To develop an understanding of the role of education for rural development.

3. To appreciate the contribution of social reformers in education for rural reconstruction.

4. To develop understanding of various national and international schemes, policies and programs of education forrural development.

5. To analyses the role of a teacher in Rural Development.

Unit I- Concept of Rural Development 25

a) Concept of Rural Area – Definition, characteristics and structure of rural community in India

b) Concept of Tribal area – Definition, characteristics needs of tribal community in India

c) Concept of Rural Development – Definition, need and importance, scope of rural development.

Unit II- POLICIES, SCHEMES AND PROGRAMS FOR RURAL DEVELOPMENT 25

I) Policies

a) Panchayat Raj after 73rd amendment and its importance for rural education and development.

b) Khadi and village Industries Commission: Objectives, Functions, Programs

c) Right to education, Education for all

II) Scheme and Programs

a) Women Empowerment- Self help group ,SEWA.

b) Health Improvement- Gram Swachata Abhiyan, National Program of Mid day meal, National Rural HealthMission.

c) Educational Scholarships , Integrated Child Development Services

d) Rashtriya Sarvashiksha Abhiyan, Strengthening of teacher's training Institutes, Setting up Model schools at Blocklevels

e. Role of a teacher in the implementation of above policies and schemes

Unit III – Education Status and Issues Reformers in Rural Areas. 25

a. Education in Rural Areas- Status and Issues.

a) Status of Education in rural areas.

i) Early childhood Education in rural area. Anganwadi, Balwadi

ii) Formal education in rural area. Primary education,Secondary education, Higher Education.

iii) Non - Formal Education and Adult education.

b. EDUCATIONAL REFORMERS IN RURAL AREAS.

a) Mahatma Gandhi, Appasaheb Patwardhan, Tarabai Modak & Anutai Wagh.

c) Experiments in Anandwan.

Internal Assessment 25

1. Seminar and Assignment 15+10

Elective – VI

Arham Yoga – I

Course - V **Arham Yoga**	**100 marks**
1. Arham Dhyan Yoga - Introduction	15
2. The meaning of Yog	15
3. Known Traditions Of the Eight Limbs Of Yoga.	15
4. Culture of Shraman Yog	15
5. Motivation behind Arham yog	15
6. Internal Assessment	25

SEMESTER V

COURSE - I	**SANSKRIT - III** V	संस्कृतम्- ॥	**100 MARKS**
Module-I	**Meghadut (Purvamegh)**		**50 Marks**
Module-II	**Bhagavadgita (Ch-III)**		**25 Marks**

Internal Assessment **25 marks**

Assignment – 10 Marks, Library Work – 05 Marks

Attendance – 05 Marks, Class Interaction – 05 Marks

Reference Book :

भगवद्गीता – गीताप्रेस, गोरखपुर

श्रीमद्भगवद्गीता – व्याख्याता प. श्रीकिशोर मिश्र, सम्पूर्णानंद संस्कृत विश्वविद्यालय, वाराणसी–221002 भगवद्गीता – प द वा जोग, प्रकाशक, एम डी रजाग, 201, महावीर पुल वि. डोंबिवली–421202 मेघदूत – एम आर काळे मोतीलाल बनारसीदास प्रकाशन, नु दिल्ली

मेघदूत – टीका, सरस्वती प्रकाशन वाराणसी

COURSE - II	**PHILOSOPHY OF YOGASHASTRA-I** II योगदर्शनेतिहासः दर्शनशास्त्र– 1	**100 MARKS**

Module-I Three Systems of Indian Philosophy- (Nastika Darshan Charvaka &Bauddha)**40 MarksModule-II** Gheranda Samhita **35 Marks**

Internal Assessment **25 marks**

Assignment – 10 Marks, Library Work – 05 Marks

Attendance – 05 Marks, Class Interaction – 05 Marks

Reference Books

1. Bharatiya tattwajnan — Shri.Srinivasa Dikshit, Any Popular Book Stall
2. Encyclopaedia of Yoga (No. 410) — Dr. RamKumar Rai

		Chowkhamba Sanskrit SansthanP.O.No: 1008, Varanasi
3.	Introduction to the Yoga Philosophy	S.C. Vasu Chowkhamba Sanskrit Sansthan P.O.No: 1008, Varanasi
4.	Yoga explained(No. 435)	Bengal Lancer Chowkhamba Sanskrit SansthanP.O.No: 1008, Varanasi
5.	Yoga Philosophy in relation to other Systems of Indian Thought	S.N. Dasgupta Chowkhamba Sanskrit Sansthan(No. 447) P.O.No: 1008, Varanasi
6.	Hathayoga Pradipika	Kaivalyadham, Lonavla
7.	Hathayoga Pradipika	Chowkhamba Sanskrit SansthanP.O.No: 1008, Varanasi

COURSE – III **APPLIED YOGA – I** योगप्रवेश **100 MARKS**

A) Planning and conducting at least month long Yoga Courses for Students: **75 Marks**

a. Health Courses
b. Personality development courses
c. Yoga for memory and concentration
d. Yoga for eyesight improvement
e. Yogic games
f. Yoga for value based education
g. Yoga course for Patients (with the help of doctors only)
h. Yoga therapy for:
Hyper-tension, diabetes, Asthma, Anxiety, neurosis, Head ache, migraine,Acidity and ulcers, Insomnia, joint pains, women's problems.
i. Discussions with patients, counselling, precautions, motivation.

Internal Assessment **25 marks**

Assignment – 10 Marks, Library Work – 05 Marks
Attendance – 05 Marks, Class Interaction – 05 Marks

Reference Books :

1. Applied Yoga - Dr. M.L. Gharote, Kaivalyadham, Lonavala.
2. Perspective in Yoga - A.K. Sinha, Bharat Manisha, Varanasi.
3. Yoga Dipika - B.K.S. Ayyangar, Orient Lormen Pvt. Ltd.,New Delhi

COURSE IV - YOGA PRACTICAL – II **100 MARKS**

Demonstration (50) & Viva (25) - **75 Marks,**

Internal Assessment **25 marks**

Assignment – 10 Marks, Library Work – 05 Marks
Attendance – 05 Marks, Class Interaction – 05 MarksThe following practices will be taught:-

1. Suryanamaskara –

1. Should be practised as Physiological, Psychological and Spiritual practice.
2. 12 repetitions with the chanting of mantras.

2. Asanas (Cultural Asanas)

A. Standing:-

1. Ardha-katichakrasana
2. Padahastasana
3. Ardha-chakrasana
4. Trikonasanaa
5. Parivrutta-Trikonasana

B. Sitting-Position:-

1. Paschimottanasana — 2. Ushtrassana
3. Vakrasana — 4. Ardhamatsyendrasana
5. Shashankasana — 6. Suptavajrasana

C. Prone on position:-
1. Bhujangasana — 2. Ardhshalabhasana
3. Shalabhasan — 4. Dhanurasana

D. Supine position :-
1. Viparitakarani — 2. Sarvangasana
3. Matsyasana — 4. Halasana
5. Shirshasana

E. Relaxative Asanas :-
1. Shavasana — 2. Makarasana

F. Meditative Asanas :-
1. Padmasana — 2. Vajrasana
3. Swastikasana — 4. Siddhasana
5. Sukhasana

BAYurasan, Vrishchikasan, Chakrasa and Matsyendrasan

Course V - Elective Papers (any one of the following can be opted)

- i) **Advanced Yoga (For Yoga Students)**
- ii) **Yoga (For Non Yoga Students)**
- iii) **Social sciences**
- iv) **Jyotisha**
- v) **Education**
- Vi) **Arham Yoga**

Elective – I

Advanced Yoga

COURSE – V	**YOGA AND POSITIVE HEALTH** योग तथा अनुकूल–स्वास्थ्य	**100 MARKS**

Module 1.	Concept of Holistic Health and WHO Concept of Adhi, Vyadhi and Panchakosh	25 Marks
Module 2.	Basic Theories of Psychology. (Psycho analysis, Individuation theory, Psychosynthesis, Gestalt psychology)	25 Marks
Module 3.	Oriental and occidental concept of mind, and mental states.	25 Marks

Internal Assessment — **25 marks**

Assignment – 10 Marks, Attendance – 05 Marks, Library Work – 05 Marks, Class Interaction – 05 Marks

Reference Books:

1. योग एवं [illegible] – डा. [illegible], इंदौर
2. योग [illegible] – श्रीकृष्ण [illegible], ठाणे पश्चिम
3. Yoga Practices for Anxiety - Dr.R.Nagarthnam, Dr.H.R.Nagendra and Depression Vivekanand Kendra Banglore.

4.	Yoga Techniques	-	Dr. M.L. Gharote Gulmohar Apartment, Bhangarwadi, Lonavala.
5.	पातञ्जल योगसूत्र रहस्य	–	डॉ. टी. कर्वाककर, हनुमान व्यायाम प्रसारक मंडळ अमरावती

Elective – II

Yoga (For Non Yoga Students) – II

Course - V **ii) Yoga (SWASTHAVRITTA)** **100 marks**

Unit I **25Marks**

Concept of health & necessity of Swasthavritta
Individual health- Daily resume (Dinacharya) Seasonal resume (Rutucharya)
The Pillars of Health (Trayopastambha)

Unit II **25 Marks**

Social health, Environmental healthAir,
Water, Light
Garbage & Swage disposal)Aapaddravya Nivarana)Industrial health & Method o maintaining it Epidemiology or infectious diseases (Selected Five)

Unit III **25 Marks**

Primary health Prevention
national health Programme
Family welfare Programme

Internal Assessment **25 marks**

Assignment –	10 Marks,	Library Work –	05 Marks
Attendance –	05 Marks,	Class Interaction	– 05 Marks

Reference Books :

1.	आयुर्वेदिक स्वस्थवृत्त	दत्तात्रय जळूकर
2.	आरोग्य शास्त्र	चुरस्ते
3.	स्वास्थ्य विज्ञान	रामसिंह
4.	स्वस्थवृत्तम	शिवकुमार गौड
5.	चामअमदजपअम –ँवबपसडमकपबपदम	श्रण्टप् पंता
6.	स्वस्थवृत्त	ई. रानडे, सरजप
~~7.~~	~~प्राथमिक योगासने तुलम साधिक आसने~~	~~जनार्दनस्वामी योगाभ्यासी, रामनगर, नागपूर~~
8.	योगदीपिका	बी.के.एस. अय्यंगार, अय्यंगार योगा इन्स्टिट्यूट, पुणे

Elective – III

Course - V **Social Science II** **100 marks**

i) Social Sciences

1.	Manusmriti Ch. 7	50 marks
2.	KautilyaArthashastra 3.11 - RunadanaPrakaranam KautilyaArthashastra 2.19 - Tulamanpoutavam	25 marks

3. Internal Assessment 25 marks

Elective – IV

Jyotish

Course - V **iii) Jyotisha (Kundali Vidnyana)** **100 marks**

Module- I	Natakala Sadhan ,Dasham lagna Sadhan, Sasandhi Dwadashabhava sadhan	**25 marks**
Module -II	Madhyamayu Sadhan,Spashtayu Sadhan,Uccha-Neecha-Swagrihadi Ayu Vichar,ChakrardhaHaani,RashmiSadhan Abhijit Dasha,Yogini Dasha.(Mishra Prakaran of B.K.V)	**25 marks**
Module- III	Videsh Kundali Sadhan-rekhansha,Akshamsha,Velantar Kranti,Char,Dinman,Deshantar Sadhan.	**25 marks**
Module- IV	Internal Assessment	**25 marks**

Text- **1) Bharatiya Kundali Vidnyan- by Meethalal Ojha, Varanasi.**
2) Jyotish sobati.

Note: Calculation and examples are covered in Internal Assessment.

Elective - V

Education

Course - V **Education** **100 marks**

I C T IN EDUCATION

Marks: 75+25=100

Objectives:

1. To develop an understanding of the conceptual bases of Instructional and Communication Technology.
2. To analyze the dynamics of communication in an educational set-up.
3. To develop an understanding of the strategies for designing instruction.
4. To develop an understanding of the concept and application of e-learning.
5. To analyze the use of Information and Communication Technology in open and distance learning.

Unit I- Basics of Information and Communication Technology 25

a. Meaning & Characteristics of Information and Communication Technology

b. Scope of Information and Communication Technology Areas: (Teaching learning Process, Evaluation, Research, Administration)

Unit II - Dynamics of Communication and Designing Instruction 25

a. Communication: Meaning, process, types and barriers

b. Transactional Analysis: Concept, Educational implications.

c. Role of teacher for effective communication.

d. Instructional Design: Meaning and characteristics

e. Self-Learning Material (Meaning, principles, guidelines for preparing SLM)f .

Meaning of Computer Assisted Learning.

g. Models of Teaching:(Concept Attainment Model, Inquiry Training Model)

Unit III- e- Learning 25

a) Meaning and characteristics of e-learning

b) Meaning and characteristics of Online learning:

c) Blended learning: Meaning, characteristics, Application(Online and Offline)

d) Legal and ethical issues in the use of IC T in education.

Plagiarism, Copy right violation, hacking

e) Open Education Resources: Meaning, types , application in education

f) M – Learning (Mobile learning):Meaning, characteristics and application software's for education

Internal Assessment **25**

1. Seminar and Assignment **15+10**

Elective – VI

Arham Yoga

Course - V **Arham Yoga** 100 marks

75

1. Arham - Five Steps Process
2. Activation
3. Relaxation
4. Healing
5. Awareness

6. Internal Marks - 25 Marks

SEMESTER VI

COURSE - I **SANSKRIT - III** **संस्कृतम् - III** **100 MARKS**

Module-I	**Meghadut (Uttaramegh)**	**50 Marks**
Module-II	**Viduraniti (Ch-I)**	**25 Marks**

Internal Assessment **25marks**

Assignment – 10 Marks, Library Work – 05 Marks
Attendance – 05 Marks, Class Interaction – 05 Marks

Reference Book :

मेघदूतम् – चौखम्बा सुरभारती प्रकाशन, वाराणसी
मेघदूतम् – एम आर काले मोतीलाल बनारसीदास प्रकाशन, नई दिल्ली
विदुरनीति – डा गजेश्वर शैली, चौखम्बा सुरभारती प्रकाशन पो.बो.1129, वाराणसी–221001 विदुरनीति – मोतीलाल बनारसीदास प्रकाशन, नई दिल्ली
विदुरनीति – गीताप्रेस, गोरखपुर, कोलकाता
विदुरनीति – सम्पादक, डा किरण शुक्ला, जे पी पब्लिशिंग हाउस, 27/28, शक्ति नगर, दिल्ली–110007

COURSE - II **PHILOSOPHY OF YOGASHASTRA-I** **100 MARKS**

योगदर्शनशास्त्र सिद्धान्त–I

Module-I Systems of Indian Philosophy- (Jain Darshan) **40 Marks**
Module-II Hatha Yoga Pradipika (Chapters-Three, four and five) **35 Marks**

Internal Assessment **25 marks**

Assignment – 10 Marks, Library Work – 05 Marks
Attendance – 05 Marks, Class Interaction – 05 Marks

Reference Books

1.	Bharatiya tattwajnan	Shri.Srinivasa Dikshit, Any Popular Book Stall .
2.	Encyclopaedia of Yoga (No. 410)	Dr. Ramkumar Rai Chowkhamba Sanskrit SansthanP.O.No: 1008, Varanasi
3.	Introduction to the Yoga Philosophy	S.C. Vasu Chowkhamba Sanskrit Sansthan P.O.No: 1008, Varanasi
4.	Yoga explained(No. 435)	Bengal Lancer Chowkhamba Sanskrit SansthanP.O.No: 1008, Varanasi
5.	Yoga Philosophy in relation to other Systems of Indian Thought	S.N. Dasgupta Chowkhamba Sanskrit Sansthan(No. 447) P.O.No: 1008, Varanasi
6.	Hathayoga Pradipika	Kaivalyadham, Lonavla
7.	Hathayoga Pradipika	Chowkhamba Sanskrit SansthanP.O.No: 1008, Varanasi

COURSE – III **APPLIED YOGA** योगप्रदीप **100 MARKS**

Application of Yoga Concepts and Practices in Allied Sciences: **75 Marks**

A) Ayurveda 15 Marks
B) Naturopathy 15 Marks
C) Psychology (Psychiatry) 15 Marks
D) Physical Education 15 Marks
E) Posture 15 Marks

Internal Assessment **25 marks**

Assignment – 10 Marks, Library Work – 05 Marks
Attendance – 05 Marks, Class Interaction – 05 Marks

Reference Books :

1. Applied Yoga - Dr. M.L. Gharote, Kaivalyadham, Lonavala.
2. Perspective in Yoga - A.K. Sinha, Bharat Manisha, Varanasi.
3. Yoga Dipika - B.K.S. Ayyangar, Orient Lormen Pvt. Ltd.,New Delhi

COURSE – IV **YOGA PRACTICAL** योगप्रात्यक्षिक **100 MARKS**

Demonstration (50) & Viva (25) - 75 Marks,

1. Suryanamaskara –

1. Should be practised as Physiological, Psychological and Spiritual practice.
2. 12 repetitions with the chanting of mantras.

2. Pranayama:-

1. Sectional Breathing
2. Suryabhedan Pranyam
3. Chandrabhedan Pranayam
4. Nadishodhan Pranayam
5. Shitali Pranayam
6. Sitkari Pranayam
7. Bhramari Pranayam
8. Bhastrika Pranayama

3. KRIYAS :-

1. Kapalabhati
2. Jalaneti
3. Sutraneti
4. Vamandhauti
5. Dandaneti
6. Trataka

4. MEDITATION :- (Different techniques such as)

1. Omkar Japa 2. Sakshibhava 3. Breath- Awareness

5. MUDRA

Internal Assessment: **25 Marks**

Internship:

Organizing at least 3 Yoga courses – each of one month duration with minimum50 participants.
Collecting the required data and submitting a report.

Course V - Elective Papers (any one of the following can be opted)

i) **Advance Yoga (For Yoga Students)**
ii) **Yoga (For Non Yoga Students)**
iii) **Social sciences**
iv) **Jyotisha**
v) **Education**
Vi) **Arham Yoga**

Elective – I Advanced Yoga

II

Elective – I **Advanced Yoga**

COURSE – V **YOGA AND POSITIVE HEALTH** **100 MARKS**

योग एवं अनुकूल-स्वास्थ्य

Module 1. **Mental Wellness, Mental disorders (Causes, symptoms and Cure):** **40 Marks**
frustration, depression, conflict, Obsession, anxiety.

Module 2. **Yoga and Mental health. Role of Yoga in curing mental disorders.** **35 Marks**

Internal Assessment **25 marks**

Assignment – 10 Marks, Library Work – 05 Marks

Attendance – 05 Marks, Class Interaction – 05 Marks

Reference Books:

1. योग एवं मनश्चिकित्सा – डॉ श्रीकृष्ण, 76 वारकाड कॉलनी इदौर
2. योग मनाचा स्वास्थ्य मनाचा – श्रीकृष्ण (घाटाहे) स्टाल कॉलनी, ठाणे (पश्चिम)
3. त्वहं पतंजलयकमे चित ावगमनजल – वतण्णछहंतजीदंदए वतण्मल्हहंमदकतं दक उमतनेपदद ऽपअमादंदक श्रमदकतंए त्वहंहसवतमण
4. त्वहं जमतंचनदेंकमनहं – वतण ाण स क्षैतवजण
ळनरतंजीत ाांजतमदजए ीवसंतुकण स्वकंसंण
5. पातञ्जल योगसूत्र भाष्य – डॉ ए टी करंजेकर, हनुमान व्यायाम प्रसारक मंडळ अमरावती

Elective – II

Yoga (For Non Yoga Students) III

Course - V **SCHOOLS OF YOGA** योगशाखा **100 marks**

Module-I **Comparative Study of following Schools of Yoga:** **75 Marks**

1.	Bhakti Yoga	-	with reference to Narada Bhakti Sutra	10 Marks
2.	Karma Yoga	-	with reference to Bhagvad Geeta	10 Marks
3.	Jnana Yoga	-	with reference to Upanishads	10 Marks
4.	Raja Yoga	-	with reference to Patanjali Yoga Sutra	10 Marks
5.	Hatha Yoga	-	with reference to Hatha Yoga Pradipika	10 Marks

Module-II Integral Yoga of Aurobindo **25 Marks**

Internal Assessment - **25 marks**

Assignment – 10 Marks Library Work – 05 Marks

Attendance – 05 Marks Class Interaction – 05 Marks

Reference Books :

1. योग के सिद्धांत एवं अभ्यास – ईश्वरलिदास जोशी, ज्ञानेश शंकर नगर विद्यापीठ, नागपुर (म.प्र.)
2. भक्तियोग – स्वामी विवेकानंद, रामकृष्ण मठ, धंतोली, नागपुर
3. कर्मयोग – रामकृष्ण मठ, धंतोली, नागपुर
4. ज्ञानयोग – रामकृष्ण मठ, धंतोली, नागपुर
5. योग, ईश्वरसेवा काउंजी – श्री अरुण खंडईकर, अमरावती

Elective – III
Social Science

Course - V	**i) Social Sciences**	**100 marks**
1.	Gramageeta of Dr.Varnekar (First 20 Chapter)	40 marks
2.	Manusmriti(II Chapter)	35 marks
3.	Internal Assessment	25 marks

Elective – IV
Jyotish

Course - V	**Jyotisha (Shastra Itihas)**	**100 marks**
Module- I	Bharatiya Jyotish-swaroop and Vikas	**25 marks**
Module -II	Bharatiya Jyitish-KalaVargikaran-upto Adikala.	**25 marks**
Module- III	PurvaMadhyakala,UttaraMadhyaKaala,ArvachinaKala	**25 marks**
Module- IV	Internal Assessment	**25 marks**
Text-	**Jyotishshastra Itihasa of Nemichand Shastri**	

Elective – V
Education

Course - V **Education** **100 marks**

EDUCATIONAL MANAGEMENT

Objectives: **Marks: 75+25=100**

1. To develop an understanding of the concept of Administration, Management and Governance.

2. To analyze the various aspects of Institutional Management.

3. To develop an understanding of the concept and significance of Institutional Quality and its Assessment.

4. To analyze the Educational System in India and the world.

Unit-I. 1. Concept of Educational Management. **25**

a) Concept of Administration, Management and Governance.

b) Educational Management: Meaning/Definition, Principles and Importance

c) Dimensions and Characteristics of Democratic Institutional Climate

Unit- II. Institutional Management. **25**

a) Institutional Planning: Concept, Process and Advantages

b) Institutional Discipline: Meaning and ways of ensuring effective,

c) Scheduling: Academic Calendar and Time Table: Types and Principles of Construction.

Unit- III. Quality Management. **25**

a) Concept of Institutional Quality

b) Quality Control- Performance Appraisal: Concept, Types and Criteria for Teachers' Performance Appraisal

c) Measures for Enhancing Institutional Management

Resource Management

a) Leadership: Styles, Roles, Challenges of Institutional Heads and Teachers.

b) Stress Management- Concept and Strategies.

c) Crisis Management: Concept and Strategies in relation to different types of Crisis e.g. Disaster.

Internal Assessment 25

1. Seminar and Assignment 15+10

Elective – VI

Arham Yoga

Course - V	**Arham Yoga**	**100 marks**
1.	8 limbs of Meditation	40
2.	Theoretical Study Of Meditation	35
3.	Internal Assessment	25 Marks

Reference Books

For Education (For Sem – IV)

Reference Books:

1. Iyer R., Moral and Political Ideas of Mahatma Gandhi, Oxford, 1975
2. Ramma Reddy G. (Ed.) Patterns of Panchayati Raj in India, Delhi, 1977
3. Mishra S. N., Rural Development and Panchayati Raj, Concept, 1981.
4. Prasad K (ed) Planning & its implementation, New Delhi, IIPA, 1984
5. Purushottam P. W.&Karmatulla M. Development Adminiatration,a Rural perspective, Delhi, kaniska
6. Bajpayi A. Panchayat Raj & Rural Development, SahityaPrakashan, Delhi,1997
7. G. Ram Reddy, Patterns of Panchayati Raj in India, MacMillion ,Delhi1971
8. NKrYadav&AKSingh,RuralRetailininIndia
9. MukundaRural Development and Poverty Eradication in India 2008
10. S C Kalwar, TejramMeenaGrameenNirdhantaUnmoolanAvem
11. S.BVerma,GraminVikas 2010
12. Prof. K. Vijaya Kumar Empowerment of Weaker Sections: Future Planning and Strategies for Rural Development in India

Education (For Sem- V)

Reference Books:

1. Abbot C. (2007) E- inclusion: Learning difficulties and digital technologies retrieved from http://archive.futurelab.org.uk/resources/documents/lit_reviews/learning_Difficulties_rev.pdf
2. Barrows, H.S. (1994), Practice based Learning: Problem based Learning applied to medical Education, Springfield, III: Southern Illinois University School of Medicine.
4. Duch, B., Groh S., Allen D. (2001). *The Power of Problem-based Learning: A Practical "how To" for Teaching Undergraduate Courses in Any Discipline*. Stylus Publishing, LLC.,

5. Kirk, Gallagher, Anastasiow& Coleman. Educating exceptional children (11thed.) Houghton Miffli Company.2006.

6. Thompson J., Bakken J., Fulk B., Karlan G. (2004) 'Using Technology to improve the Literacy skills of students with disabilities' retrieved from http://www.learningpt.org/pdfs/literacy/disability.pdf

7. Mangal S.K. &Mangal Uma. Essentials of educational technology. PHI learning pvt. Ltd. 2010.

8. Mayer, R. E. (2001). *Multimedia learning*. New York: Cambridge University Press. ISBN 0-521-78749-1.)

9. Rajsekar, S. Computer education. Neelkamal publication.2008.

10. Singh P.P. & Sharma S. e-learning new trends and innovations. Deep & deep public.Pvt. Ltd. 2005.

11. Vanaja, M & Rajasekhar S. Educational Technology Computer Education. Neelkamal blication.2006.

Websites :

1. en.wikipedia.org/

2. http://www.e-learningconsulting.com/

3. http://kserver.360training.com/kserver/KSERVER+Whitepaper+Ver1.pdf

4. http://www.timelesslearntech.com/blog/5-advantages-of-using-thelearning-management-system-lms/

5. www.m-learning.org/

Education (For Sem – VI)

Reference Books:

1. Theories of Educational Leadership and Management [Paperback], Tony Bush (Author), 2010, Sage PublicationsLtd.

2. Organizational Learning: Improving Learning, Teaching, and Leading in School Systems [Paperback], VivienneCollinson (Author), Tanya Fedoruk Cook (Author),2007, Sage Publications India Pvt. Ltd,

3. Essentials of Management, : An International Perspective [Paperback],Harold Koontz (Author), Heinz Weihrich (Contributor),2009, Publishers-Tata McGraw Hill Education Pvt. Ltd.

4. Educational Management, Ashima V. Deshmukh, Anuj P. Naik, Publisher: Himalaya Publishing House (2010)

5. Administration and Management of Education (Hardcover), by Dr. S. R. Pandya, Publisher: Himalaya PublishingHouse Pvt. Ltd. (2001)

6. Educational Management: Redefining Theory, Policy and Practice (Paperback) by Tony Bush (Editor), Les Bell(Editor), Ray Bolam (Editor),

7. Educational Administration Supervison& School Management (Hardcover), by Mohanty, Jagannath, Publisher:Deep & Deep Publications Pvt. Ltd,(2005).

8. A Text Book of Management Information System, by Deepak Singh Publisher: Vision Publications (2009)

9. Recommendations of the National Knowledge Commission, Author: Government of India National Knowledge Commission, Publisher, Academic Foundation, 2010, ISBN 8171887678, 9788171887675.

10. Educational Administration, Supervision And School Management, By J. Mohanty, 2005, NCERT Publicationsof India

11. Educational Administration And Management: An Integrated Approach, by S.L. Goel, Aruna Goel

12. Sultana Shaikh, Paalimi Insaran (2012), Deccan traders, Educational publishers, Hyderabad. (Urdu)

BACHELOR OF COMPUTER APPLICATION

(B.C.A.)

(THREE YEAR DEGREE COURSE)

BACHELOR OF COMPUTER APPLICATION (B.C.A.)

COURSE STRUCTURE

FIRST YEAR

Ist SEMESTER

Course Code	Paper / Subject Name	External / Term Exam Max. Marks	Internal Assessment Max. Marks	Total Max. Marks
BCA-S101	Computer Fundamental & Office Automation	**75**	**25**	**100**
BCA-S102	Programming Principle & Algorithm	**75**	**25**	**100**
BCA-S103	Principle of Management	**75**	**25**	**100**
BCA-S104	Business Communication	**75**	**25**	**100**
BCA-S105	Mathematics –I	**75**	**25**	**100**
BCA-S106 (a)	Computer Laboratory and Practical Work of Office Automation	----------	----------	**50**
BCA-S106 (b)	Computer Laboratory and Practical Work of Programming Principle & Algorithm	----------	----------	**50**
Total Marks of Ist Semester				**600**

BACHELOR OF COMPUTER APPLICATION (B.C.A.)

COURSE STRUCTURE

FIRST YEAR

IInd SEMESTER

Course Code	Paper / Subject Name	External / Term Exam Max. Marks	Internal Assessment Max. Marks	Total Max. Marks
BCA-S107	C Programming	**75**	**25**	**100**
BCA-S108	Digital Electronics & Computer Organization	**75**	**25**	**100**
BCA-S109	Organization Behavior	**75**	**25**	**100**
BCA-S110	Financial Accounting & Management	**75**	**25**	**100**
BCA-S111	Mathematics –II	**75**	**25**	**100**
BCA-S112	Computer Laboratory and Practical Work of C Programming	----------	----------	**100**
Total Marks of IInd Semester				**600**

BACHELOR OF COMPUTER APPLICATION (B.C.A.)

COURSE STRUCTURE

SECOND YEAR

IIIrd SEMESTER

Course Code	Paper / Subject Name	External / Term Exam Max. Marks	Internal Assessment Max. Marks	Total Max. Marks
BCA-S201	Object Oriented Programming Using C++	**75**	**25**	**100**
BCA-S202	Data Structure Using C & C++	**75**	**25**	**100**
BCA-S203	Computer Architecture & Assembly Language	**75**	**25**	**100**
BCA-S204	Business Economics	**75**	**25**	**100**
BCA-S205	Elements of Statistics	**75**	**25**	**100**
BCA-S206 (a)	Computer Laboratory and Practical Work of OOPS	----------	----------	**50**
BCA-S206 (b)	Computer Laboratory and Practical Work of DS	----------	----------	**50**
Total Marks of IIIrd Semester				**600**

BACHELOR OF COMPUTER APPLICATION (B.C.A.)

COURSE STRUCTURE

SECOND YEAR

IVth SEMESTER

Course Code	Paper / Subject Name	External / Term Exam Max. Marks	Internal Assessment Max. Marks	Total Max. Marks
BCA-S207	Computer Graphics & Multimedia Application	**75**	**25**	**100**
BCA-S208	Operating System	**75**	**25**	**100**
BCA-S209	Software Engineering	**75**	**25**	**100**
BCA-S210	Optimization Techniques	**75**	**25**	**100**
BCA-S211	Mathematics-III	**75**	**25**	**100**
BCA-S212	Computer Laboratory and Practical Work of Computer Graphics & Multimedia Application	----------	----------	**100**
Total Marks of IVth Semester				**600**

BACHELOR OF COMPUTER APPLICATION (B.C.A.)

COURSE STRUCTURE

THIRD YEAR

Vth SEMESTER

Course Code	Paper / Subject Name	External / Term Exam Max. Marks	Internal Assessment Max. Marks	Total Max. Marks
BCA-S301	Introduction to DBMS	**75**	**25**	**100**
BCA-S302	Java Programming and Dynamic Webpage Design	**75**	**25**	**100**
BCA-S303	Computer Network	**75**	**25**	**100**
BCA-S304	Numerical Methods	**75**	**25**	**100**
BCA-S305 (a)	Minor Project	----------	----------	**50**
BCA-S305 (b)	Viva-Voice on Summer Training	----------	----------	**50**
BCA-S306 (a)	Computer Laboratory and Practical Work of DBMS	----------	----------	**50**
BCA-S306 (b)	Computer Laboratory and Practical Work of Java Programming & Dynamic Webpage Design	----------	----------	**50**
Total Marks of Vth Semester				**600**

BACHELOR OF COMPUTER APPLICATION (B.C.A.)

COURSE STRUCTURE

THIRD YEAR

VIth SEMESTER

Course Code	Paper / Subject Name	External / Term Exam Max. Marks	Internal Assessment Max. Marks	Total Max. Marks
BCA-S307	Computer Network Security	**75**	**25**	**100**
BCA-S308	Information System: Analysis Design & Implementation	**75**	**25**	**100**
BCA-S309	E-Commerce	**75**	**25**	**100**
BCA-S310	Knowledge Management	**75**	**25**	**100**
BCA-S311	Major Project	----------	----------	**150**
BCA-S312	Presentation/Seminar based on Major Project	----------	----------	**50**
Total Marks of VIth Semester				**600**

First Semester	**600 Marks**
Second Semester	**600 Marks**
Third Semester	**600 Marks**
Fourth Semester	**600 Marks**
Fifth Semester	**600 Marks**
Sixth Semester	**600 Marks**

Total Marks = 3600

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BACHELOR OF COMPUTER APPLICATION (B.C.A.)

DETAILED SYLLABUS

FIRST SEMSTER

COURSE CODE : BCA – S101

Computer Fundamental & Office Automation

UNIT-I

Introduction to Computers

Introduction, Characteristics of Computers, Block diagram of computer. Types of computers and features, Mini Computers, Micro Computers, Mainframe Computers, Super Computers. Types of Programming Languages (Machine Languages, Assembly Languages, High Level Languages). Data Organization, Drives, Files, Directories. Types of Memory (Primary And Secondary) RAM, ROM, PROM, EPROM. Secondary Storage Devices (FD, CD, HD, Pen drive) I/O Devices (Scanners, Plotters, LCD, Plasma Display) Number Systems Introduction to Binary, Octal, Hexadecimal system Conversion, Simple Addition, Subtraction, Multiplication.

UNIT-II

Algorithm and Flowcharts

Algorithm: Definition, Characteristics, Advantages and disadvantages, Examples Flowchart: Definition, Define symbols of flowchart, Advantages and disadvantages, Examples.

UNIT-III

Operating System and Services in O.S.

Dos – History, Files and Directories, Internal and External Commands, Batch Files, Types of O.S.

UNIT-IV

Windows Operating Environment

Features of MS – Windows, Control Panel, Taskbar, Desktop, Windows Application, Icons, Windows Accessories, Notepad, Paintbrush.

UNIT-V

Editors and Word Processors

Basic Concepts, Examples: MS-Word, Introduction to desktop publishing.

UNIT-VI

Spreadsheets and Database packages

Purpose, usage, command, MS-Excel, Creation of files in MS-Access, Switching between application, MS-PowerPoint.

Referential Books:

1. Fundamental of Computers – By V.Rajaraman B.P.B. Publications
2. Fundamental of Computers – By P.K. Sinha
3. Computer Today- By Suresh Basandra
4. Unix Concepts and Application – By Sumitabha Das
5. MS-Office 2000(For Windows) – By Steve Sagman
6. Computer Networks – By Tennenbum Tata MacGrow Hill Publication

BACHELOR OF COMPUTER APPLICATION (B.C.A.)

DETAILED SYLLABUS

FIRST SEMSTER

COURSE CODE : BCA – S102

Programming Principle & Algorithm

UNIT-I

Introduction to 'C' Language

History, Structures of 'C' Programming, Function as building blocks.

Language Fundamentals

Character set, C Tokens, Keywords, Identifiers, Variables, Constant, Data Types, Comments.

UNIT-II

Operators

Types of operators, Precedence and Associativity, Expression, Statement and types of statements.

Build in Operators and function

Console based I/O and related built in I/O function: printf(), scanf(), getch(), getchar(), putchar(); Concept of header files, Preprocessor directives: #include, #define.

UNIT-III

Control structures

Decision making structures: If, If-else, Nested If-else, Switch; Loop Control structures: While, Do-while, for, Nested for loop; Other statements: break, continue, goto, exit.

UNIT-IV

Introduction to problem solving

Concept: problem solving, Problem solving techniques (Trail & Error, Brain Stroming, Divide & Conquer) Steps in problem solving (Define Problem, Analyze Problem, Explore Solution) Algorithms and Flowcharts (Definitions, Symbols), Characteristics of an algorithm Conditionals in pseudo-code, Loops in pseudo code

Time complexity: Big-Oh notation, efficiency Simple Examples: Algorithms and flowcharts (Real Life Examples).

UNIT-V

Simple Arithmetic Problems

Addition / Multiplication of integers, Determining if a number is +ve / -ve / even / odd, Maximum of 2 numbers, 3 numbers, Sum of first n numbers, given n numbers, Integer division, Digit reversing, Table generation for n, a^b, Factorial, sine series, cosine series, ${}^nC_r$, Pascal Triangle, Prime number, Factors of a number, Other problems such as Perfect number, GCD numbers etc (Write algorithms and draw flowchart), Swapping

UNIT-VI

Functions

Basic types of function, Declaration and definition, Function call, Types of function, Parameter passing, Call by value, Call by reference, Scope of variable, Storage classes, Recursion.

Referential Books :

1. Let us C-Yashwant Kanetkar.
2. Programming in C-Balguruswamy
3. The C programming Lang., Pearson Ecl - Dennis Ritchie
4. Structured programming approach using C- Forouzah & Ceilber Thomson learning publication.
5. Pointers in C – Yashwant Kanetkar
6. How to solve it by Computer – R.G. Dromy Peter Norton's Introduction to Computers – Tata McGHill

BACHELOR OF COMPUTER APPLICATION (B.C.A.)

DETAILED SYLLABUS

FIRST SEMSTER

COURSE CODE : BCA – S103

Principle of Management

UNIT-I

Nature of Management:

Meaning, Defination, it's nature purpose, importance & Functions, Management as Art, Science & Profession- Management as social System Concepts of management-Administration-Organization, Management Skills, Levels of Management.

UNIT-II

Evolution of Management Thought:

Contribution of F.W.Taylor, Henri Fayol, Elton Mayo, Chester Barhard & Peter Drucker to the management thought. Business Ethics & Social Responsibility: Concept, Shift to Ethics, Tools of Ethics.

UNIT-III

Functions of Management: Part-I

Planning – Meaning- Need & Importance, types, Process of Planning, Barriers to Effective Planning, levels – advantages & limitations. Forecasting- Need & Techniques. Decision making-Types - Process of rational decision making & techniques of decision making Organizing – Elements of organizing & processes: Types of organizations, Delegation of authority – Need, difficulties. Delegation – Decentralization. Staffing – Meaning & Importance Direction – Nature – Principles
Communication – Types & Importance.

UNIT-IV

Functions of Management: Part-II

Motivation – Importance – theories
Leadership – Meaning – styles, qualities & function of leader
Controlling – Need, Nature, importance, Process & Techniques, Total Quality Management Coordination – Need – Importance.

UNIT – V

Management of Change: Models for Change, Force for Change, Need for Change, Alternative Change Techniques, New Trends in Organization Change, Stress Management.

UNIT-VI

Strategic Management

Definition, Classes of Decisions, Levels of Decision, Strategy, Role of different Strategist, Relevance of Strategic Management and its Benefits, Strategic Management in India

Referential Books :

1. Essential of Management – Horold Koontz and Iteinz Weibrich- McGrawhills International.
2. Management Theory & Practice – J.N.Chandan.
3. Essential of Business Administration – K.Aswathapa, Himalaya Publishing House.
4. Principles & practice of management – Dr. L.M.Parasad, Sultan Chand & Sons – New Delhi.
5. Business Organization & Management – Dr. Y.K.Bhushan
6. Management: Concept and Strategies By J.S. Chandan, Vikas Publishing
7. Principles of Management, By Tripathi, Reddy Tata McGraw Hill
8. Business organization and Management by Talloo by Tata McGraw Hill
9. Business Environment and Policy – A book on Strategic Management/ Corporate Planning By Francis Cherunilam Himalaya Publishing House 2001 Edition.

BACHELOR OF COMPUTER APPLICATION (B.C.A.)

DETAILED SYLLABUS

FIRST SEMSTER

COURSE CODE : BCA – S104

Business Communication

UNIT-I

Means of Communication:

Meaning and Definition – Process – Functions – Objectives – Importance – Essentials of good communication – Communication barriers, 7C's of Communication.

UNIT-II

Types of Communication: Oral Communication:

Meaning, nature and scope – Principle of effective oral communication – Techniques of effective speech – Media of oral communication (Face -to-face conversation – Teleconferences – Press Conference – Demonstration – Radio Recording – Dictaphone – Meetings – Rumour – Demonstration and Dramatisation – Public address system – Grapevine – Group Discussion – Oral report – Closed circuit TV). The art of listening – Principles of good listening.

UNIT-III

Written Communication

Purpose of writing, Clarity in Writing, Pricinciple of Effective writing, Writing Techniques, Electronic Writing Process.

UNIT-IV

Business Letters & Reports:

Need and functions of business letters – Planning & layout of business letter – Kinds of business letters – Essentials of effective correspondence, Purpose, Kind and Objective of Reports, Writing Reports.

UNIT-V

Drafting of business letters:

Enquiries and replies – Placing and fulfilling orders – Complaints and follow-up Sales letters – Circular letters Application for employment and resume.

UNIT-VI

Information Technology for Communication:

Word Processor – Telex – Facsimile(Fax) – E-mail – Voice mail –Internet – Multimedia – Teleconferencing – Mobile Phone Conversation – Video Conferencing –SMS – Telephone Answering Machine – Advantages and limitations of these types.

Topics Prescribed for workshop/skill lab

Group Discussion, Mock Interview, Decision Making in a Group.

Referential Books :

1. Business Communication – K.K.Sinha – Galgotia Publishing Company, New Delhi.
2. Media and Communication Management – C.S. Rayudu – Hikalaya Publishing House, Bombay.
3. Essentials of Business Communication – Rajendra Pal and J.S. Korlhalli- Sultan Chand & Sons, New Delhi.
4. Business Communication (Principles, Methods and Techniques) Nirmal Singh – Deep &Deep Publications Pvt. Ltd., New Delhi.
5. Business Communication – Dr.S.V.Kadvekar, Prin.Dr.C.N.Rawal and Prof.Ravindra Kothavade- Diamond Publications, Pune.
6. Business Correspondence and Report Writing – R.C. Sharma, Krishna Mohan – Tata McGraw-Hill Publishing Company Limited, New Delhi.
7. Communicate to Win – Richard Denny – Kogan Page India Private Limited, New Delhi.
8. Modern Business Correspondence – L.Gartside – The English Language Book Society and Macdonald and Evans Ltd.
9. Business Communication – M.Balasubrahmanyan –Vani Education Books.
10. Creating a Successful CV –Siman Howard – Dorling Kidersley.

BACHELOR OF COMPUTER APPLICATION (B.C.A.)

DETAILED SYLLABUS

FIRST SEMSTER

COURSE CODE : BCA – S105

Mathematics -I

UNIT-I

DETERMINANTS:

Definition, Minors, Cofactors, Properties of Determinants MATRICES: Definition, Types of Matrices, Addition, Subtraction, Scalar Multiplication and Multiplication of Matrices, Adjoint, Inverse, Cramers Rule, Rank of Matrix Dependence of Vectors, Eigen Vectors of a Matrix, Caley-Hamilton Theorem (without proof).

UNIT-II

LIMITS & CONTINUITY:

Limit at a Point, Properties of Limit, Computation of Limits of Various Types of Functions, Continuity at a Point, Continuity Over an Interval, Intermediate Value Theorem, Type of Discontinuities

UNIT-III

DIFFERENTIATION:

Derivative, Derivatives of Sum, Differences, Product & Quotients, Chain Rule, Derivatives of Composite Functions, Logarithmic Differentiation, Rolle's Theorem, Mean Value Theorem, Expansion of Functions (Maclaurin's & Taylor's), Indeterminate Forms, L' Hospitals Rule, Maxima & Minima, Curve Tracing, Successive Differentiation & Liebnitz Theorem.

UNIT-IV

INTEGRATION:

Integral as Limit of Sum, Fundamental Theorem of Calculus(without proof.), Indefinite Integrals, Methods of Integration Substitution, By Parts, Partial Fractions, Reduction Formulae for Trigonometric Functions, Gamma and Beta Functions(definition).

UNIT-V

VECTOR ALGEBRA:

Definition of a vector in 2 and 3 Dimensions; Double and Triple Scalar and Vector Product and physical interpretation of area and volume.

Referential Books :

1. B.S. Grewal, “Elementary Engineering Mathematics”, 34th Ed., 1998.
2. Shanti Narayan, “Integral Calculus”, S. Chand & Company, 1999
3. H.K. Dass, “Advanced Engineering Mathematics”, S. Chand & Company, 9th Revised Edition, 2001.
4. Shanti Narayan, “Differential Caluculs”, S.Chand & Company, 1998.

BACHELOR OF COMPUTER APPLICATION (B.C.A.)

DETAILED SYLLABUS

FIRST SEMSTER

COURSE CODE : BCA – S106 (a)

Computer Laboratory & Practical Work of Office Automation

Practical will be based on Paper Office Automation:

Covers UNIT-III, UNIT-IV, UNIT-V, UNIT-VI of Syllabus

BACHELOR OF COMPUTER APPLICATION (B.C.A.)

DETAILED SYLLABUS

FIRST SEMSTER

COURSE CODE : BCA – S106 (b)

Computer Laboratory and Practical Work of Programming

Principle & Algorithm

Practical will be based on Paper:

Programming Principle & Algorithm:

Covers UNIT-III, UNIT-IV, UNIT-V, UNIT-VI of Syllabus

BACHELOR OF COMPUTER APPLICATION (B.C.A.)

DETAILED SYLLABUS

SECOND SEMSTER

COURSE CODE : BCA – S107

C Programming

UNIT-I

Arrays

Definition, declaration and initialization of one dimensional array; Accessing array elements; Displaying array elements; Sorting arrays; Arrays and function; Two-Dimensional array: Declaration and Initialization, Accessing and Displaying, Memory representation of array [Row Major, Column Major]; Multidimensional array.

UNIT-II

Pointers

Definition and declaration, Initialization; Indirection operator, address of operator; pointer arithmetic; dynamic memory allocation; arrays and pointers; function and pointers.

UNIT-III

Strings

Definition, declaration and initialization of strings; standard library function: strlen(), strcpy(), strcat(), strcmp(); Implementation without using standard library functions.

UNIT-IV

Structures

Definition and declaration; Variables initialization; Accessing fields and structure operations; Nested structures; Union: Definition and declaration; Differentiate between Union and structure.

UNIT-V

Introduction C Preprocessor

Definition of Preprocessor; Macro substitution directives; File inclusion directives; Conditional compilation.

Bitwise Operators

Bitwise operators; Shift operators; Masks; Bit field.

UNIT-VI File handling

Definition of Files, Opening modes of files; Standard function: fopen(), fclose(), feof(), fseek(), fewind();Using text files: fgetc(), fputc(), fscanf().

Command line arguments

Referential Books:

1. Let us C-Yashwant Kanetkar.
2. Programming in C-Balguruswamy
3. The C programming Lang., Person Ecl – Dennis Ritchie
4. Structured programming approach using C-Forouzah & Ceilberg Thomson learning publication.

BACHELOR OF COMPUTER APPLICATION (B.C.A.)

DETAILED SYLLABUS

SECOND SEMSTER

COURSE CODE : BCA – S108

Digital Electronics & Computer Organization

UNIT-I

Logic gates and circuit

Gates (OR, AND, NOR, NAND, XOR & XNOR); Demogran's laws; Boolean laws, Circuit designing techniques (SOP, POS, K-Map).

UNIT-II

Combinational Building Blocks

Multiplexes; Decoder; Encoder; Adder and Subtracter.

UNIT-III

Memories

ROMs, PROMs, EPROMs, RAMs, Hard Disk, Floppy Disk and CD-ROM.

UNIT-IV

Sequential Building Blocks

Flip-Flop (RS, D, JK, Master-slave & & T flip-flops); Registers & Shift registers; Counters; Synchronous and Asynchronous Designing method.

UNIT-V

Memory Organization: Basic cell of static and dynamic RAM; Building large memories using chips; Associative memory; Cache memory organization and Virtual memory organization.

Referential Books:

1. Digital Logic and Computer design (PHI) 1998 : M.M. Mano
2. Computer Architecture (PHI) 1998 : M.M. Mano

3. Digital Electronics (TMH) 1998 : Malvino and Leach
4. Computer Organization and Architecture : William Stallings
5. Digital fundamentals (Universal Book Stall) 1998 : Floyd, L.Thomas
6. Computer Organization (MC Graw-Hill, Signapore) : Hamcher, Vranesic and Zaky

BACHELOR OF COMPUTER APPLICATION (B.C.A.)

DETAILED SYLLABUS

SECOND SEMSTER

COURSE CODE : BCA – S109

Organization Behavior

UNIT-I

Fundamentals of Organizational Behaviour

Nature, Scope, Definition and Goals of Organizational Behaviour; Fundamental Concepts of Organizational Behaviour; Models of Organizational Behaviour; Emerging aspects of Organizational Behaviour: Meaning Cultural Diversity, Managing the Perception Process.

UNIT-II

Perception, Attitude, Values and Motivation

Concept, Nature, Process, Importance, Management Behavioural aspect of Perception. Effects of employee attitudes; Personal and Organizational Values; Job Satisfaction; Nature and Importance of Motivation; Achievement Motive; Theories of Work Motivation: Maslow's Need Hierarchy Theory McGregcrs's Theory 'X' and Theory 'Y'.

UNIT-III

Personality

Definition of Personality, Determinants of Personality; Theories of Personality- Trait and Type Theories, The Big Five Traites, Mytes-Briggs Indicator; Locus of Control, SType A and Type B Assessment of Personality.

UNIT-IV Work Stress

Meaning and definition of Stress, Symptoms of Stress; Sources of Stress: Individual Level, Group Level, Organizational Level; Stressors, Extra Organizational Stressors; Effect of Stress – Burnouts; Stress Management – Individual Strategies, Organizational Strategies; Employee Counselling.

UNIT-V

Group Behaviour and Leadership

Nature of Group, Types of Groups; Nature and Characteristics of team; Team Building, Effective Teamwork; Nature of Leadership, Leadership Styles; Traits of Effective Leaders.

UNIT-VI

Conflict in Organizations

Nature of Conflict, Process of Conflict; Levels of Conflict – Intrapersonal, Interpersonal; Sources of Conflict; Effect of Conflict; Conflict Resolution, Meaning and types of Grievances & Process of Grievances Handling.

Referential Books:

1. Organizational Behavior Text, Cases and Games- By K.Aswathappa, Himalaya Publishing House, Mumbai, Sixth Edition (2005)
2. Organizational Behavior Human Behavior at Work By J.W. Newstrom, Tata McGraw Hill Publishing Company Limited, New Delhi, 12th Edition (2007)
3. Organizational Behavior – By Fred Luthans
4. Organizational Behavior – By Super Robbins
5. Organizational Behavior – Anjali Ghanekar
6. Organizational Behavior Fundamentals, Realities and Challenges By Detra Nelson, James Campbel Quick Thomson Publications
7. Organizational Behavior through Indian Philosophy, By N.M.Mishra, Hikalaya Publication House

BACHELOR OF COMPUTER APPLICATION (B.C.A.)

DETAILED SYLLABUS

SECOND SEMSTER

COURSE CODE : BCA – S110

Financial Accounting & Management

UNIT-I

Overview - Meaning and Nature of Financial Accounting, Scope of Financial Accounting, Financial Accounting & Management Accounting, Accounting concepts & convention, Accounting standards in India.

UNIT-II

Basics of accounting – Capital & Revenue items, Application of Computer in Accounting Double Entry System, Introduction to Journal, Ledger and Procedure for Recording and Posting, Introduction to Trail Balance, Preparation of Final Account, Profit & Loss Account and related concepts, Balance Sheet and related concept.

UNIT-III

Financial statement analysis: Ratio analysis, Funds flow analysis, concepts, uses, Preparation of funds flow statement, simple problem, Cash flow analysis, Concepts, uses, preparation of cash flow statement, simple problem, Break – even analysis.

UNIT-IV

Definition nature and Objective of Financial Management, Long Term Sources of Finance, Introductory idea about capitalization, Capital Structure, Concept of Cost of Capital, introduction, importance, explicit & implicit cost, Measurement of cost of capital, cost of debt.

UNIT-V

Concept & Components of working Capital. Factors Influencing the Composition of working Capital, Objectives of working Capital Management – Liquidity Vs. Profitability and working capital policies. Theory of working capital: Nature and concepts.

UNIT-VI

Cash Management, Inventory Management and Receivables Management.

Referential Books:

1. Maheshwari & Maheshwari, "An Introduction to Accountancy", 8th Edition, Vikas Publishing House, 2003
2. Gupta R.L., Gupta V.K., "Principles & Practice of Accountancy", Sultan Chand & Sons, 1999.
3. Khan & Jain, "Financial Accounting"
4. Maheshwari S.N., "Principles of Management Accounting", 11th Edition, Sultan Chand & Sons, 2001.
5. Shukla and Grewal, "Advanced Accounts", 14th Edition, Sultan Chand & Sons.

BACHELOR OF COMPUTER APPLICATION (B.C.A.)

DETAILED SYLLABUS

SECOND SEMSTER

COURSE CODE : BCA – S111

Mathematics II

UNIT-I

SETS

Sets, Subsets, Equal Sets Universal Sets, Finite and Infinite Sets, Operation on Sets, Union, Intersection and Complements of Sets, Cartesian Product, Cardinality of Set, Simple Applications.

UNIT-II

RELATIONS AND FUNCTIONS

Properties of Relations, Equivalence Relation, Partial Order Relation Function: Domain and Range, Onto, Into and One to One Functions, Composite and Inverse Functions, Introduction of Trignometric, Logarithmic and Exponential Functions.

UNIT-III

PARTIAL ORDER RELATIONS AND LATTICES

Partial Order Sets, Representation of POSETS using Hasse diagram, Chains, Maximal and Minimal Point, Glb, lub, Lattices & Algebric Systems, Principle of Duality, Basic Properties, Sublattices, Distributed & Complemented Lattics.

UNIT-IV

FUNCTIONS OF SEVERAL VARIABLES

Partial Differentiation, Change of Variables, Chain Rule, Extrema of Functions of 2 Variables, Euler's Theorem.

UNIT-V

3D COORDINATE GEOMETRY

3D Coordinate Geometry: Coordinates in Space, Direction Cosines, Angle Between Two Lines, Projection of Join of Two Points on a Plane, Equations of Plane, Straight Lines, Conditions for a line to lie on a plane, Conditions for Two Lines to be Coplanar, Shortest Distance Between Two Lines, Equations of Sphere, Tangent plane at a point

on the sphere.

UNIT-VI

MULTIPLE INTEGRATION

Double Integral in Cartesian and Polar Coordinates to find Area, Change of Order of Integration, Triple Integral to Find Volume of Simple Shapes in Cartesian Coordinates.

Referential Books:

1. Kolman, Busby and Ross, “Discrete Mathematical Structure”, PHI, 1996.
2. S.K. Sarkar, “Discrete Maths”; S. Chand & Co., 2000

BACHELOR OF COMPUTER APPLICATION (B.C.A.)

DETAILED SYLLABUS

SECOND SEMSTER

COURSE CODE : BCA – S112

Computer Laboratory and Practical Work of C Programming

Practical will be based on Paper:

Programming Principle & Algorithm:

Covers UNIT-III, UNIT-IV, UNIT-V, UNIT-VI of Syllabus

BACHELOR OF COMPUTER APPLICATION (B.C.A.)

DETAILED SYLLABUS

THIRD SEMSTER

COURSE CODE : BCA – S201

Object Oriented Programming Using C++

UNIT-I

Introduction

Introducing Object – Oriented Approach, Relating to other paradigms {Functional, Data decomposition}.

Basic terms and ideas

Abstraction, Encapsulation, Inheritance, Polymorphism, Review of C, Difference between C and C++ - cin, cout, new, delete, operators.

UNIT-II

Classes and Objects

Encapsulation, information hiding, abstract data types, Object & classes, attributes, methods, C++ class declaration, State idendity and behaviour of an object, Constructors and destructors, instantiation of objects, Default parameter value, object types, C++ garbage collection, dynamic memory allocation, Metaclass / abstract classes.

UNIT-III

Inheritance and Polymorphism

Inheritance, Class hierarchy, derivation – public, private & protected, Aggregation, composition vs classification hierarchies, Polymorphism, Categorization of polymorphism techniques, Method polymorphism, Polymorphism by parameter, Operator overloading, Parameteric Polymorphism

UNIT-IV Generic function

Template function, function name overloading, Overriding inheritance methods, Run time polymorphism, Multiple Inheritance.

UNIT-V

Files and Exception Handling

Streams and files, Namespaces, Exception handling, Generic Classes

Referential Books:

1. A.R.Venugopal, Rajkumar, T. Ravishanker “Mastering C++”, TMH, 1997**.**
2. S.B.Lippman & J.Lajoie, “ C++ Primer”, 3rd Edition, Addison Wesley, 2000.The C programming Lang., Person Ecl – Dennis Ritchie
3. R.Lafore, “Object Oriented Programming using C++”, Galgotia Publications, 2004
4. D.Parasons, “Object Oriented Programming using C++”, BPB Publication.

BACHELOR OF COMPUTER APPLICATION (B.C.A.)

DETAILED SYLLABUS

THIRD SEMSTER

COURSE CODE : BCA – S202

Data Structure Using C & C++

UNIT-I

Introduction to Data Structure and its Characteristics Array

Representation of single and multidimensional arrays; Sprase arrays – lower and upper triangular matrices and Tridiagonal matrices with Vector Representation also.

UNIT-II

Stacks and Queues

Introduction and primitive operations on stack; Stack application; Infix, postfix, prefix expressions; Evaluation of postfix expression; Conversion between prefix, infix and postfix, introduction and primitive operation on queues, D- queues and priority queues.

UNIT-III

Lists

Introduction to linked lists; Sequential and linked lists, operations such as traversal, insertion, deletion searching, Two way lists and Use of headers

UNIT-IV

Trees

Introduction and terminology; Traversal of binary trees; Recursive algorithms for tree operations such as traversal, insertion, deletion; Binary Search Tree

UNIT-V

B-Trees

Introduction, The invention of B-Tree; Statement of the problem; Indexing with binary search trees; a better approach to tree indexes; B-Trees; working up from the bottom; Example for creating a B-Tree.

UNIT-VI

Sorting Techniques; Insertion sort, selection sort, merge sort, heap sort, searching Techniques: linear search, binary search and hashing

Referential Books:

1. E.Horowiz and S.Sahani, " Fundamentals of Data structures", Galgotia Book source Pvt. Ltd., 2003
2. R.S.Salaria, " Data Structures & Algorithms" , Khanna Book Publishing Co. (P) Ltd..,2002
3. Y.Langsam et. Al., " Data Structures using C and C++" , PHI, 1999

BACHELOR OF COMPUTER APPLICATION (B.C.A.)

DETAILED SYLLABUS

THIRD SEMSTER

COURSE CODE : BCA – S203

Computer Architecture & Assembly Language

UNIT-I

Basic computer organization and design, Instructions and instruction codes, Timing and control/ instruction cycle, Register/ Types of register/ general purpose & special purpose registers/ index registers, Register transfer and micro operations/ register transfer instructions, Memory and memory function, Bus/ Data transfer instructions, Arithmetic logic micro-operations/ shift micro-operations, Input/ Output and interrupts, Memory reference instructions, Memory interfacing memory/ Cache memory.

UNIT-II

Central Processing Unit

General Register Organization/ stacks organizations instruction formats, addressing modes, Data transfer and manipulation. Program control reduced computer, pipeline/ RISC/ CISC pipeline vector processing/ array processing.

Arithmetic Algorithms: Integer multiplication using shift and add, Booth's algorithm, Integer division, Floating-point representations.

UNIT-III

Computer Arithmetic

Addition, subtraction and multiplication algorithms, divisor algorithms. Floating point, arithmetic operations, decimal arithmetic operations, decimal arithmetic operations.

UNIT-IV

Input – Output Organization

Peripheral devices, Input/output interface, ALU Asynchronous Data transfer, mode of transfer, priority interrupts, Direct memory Address (DMA), Input/ Output processor (IOP), serial communication.

UNIT-V

Evaluation of Microprocessor

Overview of Intel 8085 to Intel Pentium processors Basic microprocessors, architecture and interface, internal architecture, external architecture memory and input/ output interface.

UNIT-VI

Assembly language, Assembler, Assembly level instructions, macro, use of macros in I/C instructions, program loops, programming arithmetic and logic subroutines, Input-Output programming.

Referential Books:

1. Leventhal, L.A, “Introduction to Microprocessors”, Prentice Hall of India
2. Mathur, A.P., “Introduction to Microprocessors” , Tata McGraw Hill
3. Rao,P.V.S., “Prospective in Computer Architechture” , Prentice Hall of India

BACHELOR OF COMPUTER APPLICATION (B.C.A.)

DETAILED SYLLABUS

THIRD SEMSTER

COURSE CODE : BCA – S204

Business Economics

UNIT-I

The Scope and Method of Economics, the Economic Problem: Scarity & Choice, The Price Mechanism, Demand & Supply Equilibrium: The Concept of Elasticity and it's Applications.

The Production Process: output decisions – Revenues Costs and Profit Maximisation **Laws of returns & Returns to Scale:** Economics and Diseconomies of scale.

UNIT-II

Market Structure: Equilibrium of a firm and Price, Output Determination under Perfect Competition Monopoly, Monoplastic Competition & Oligopoly

UNIT-III

Macro Economic Concerns

Inflalation, Unemployment, Trade-Cycles, Circular Flow upto Four Sector Economy, Government in the Macro Economy: Fiscal Policy, Monetary Policy, Measuring national Income and Output

UNIT-IV

The World Economy – WTO, Globalisation, MNC's, Outsourcing, Foreign Capital in India, Trips, Groups of Twenty (G-20), Issues of dumping, Export-Import Policy 2004-2009

Referential Books:

1. Ahuja H.L., "Business Economics",S.Chand & Co., New Delhi, 2001
2. Ferfuson P.R., Rothchild, R and Fergusen G.J."Business Economics" Mac-millan, Hampshire, 1993

3. Karl E.Case & Ray C. fair , “Principles of Economics” , Pearson Education , Asia, 2000

4. Nellis, Joseph, Parker David, “ The Essence of Business Economics”,Prentice Hall, New Delhi, 1992.

BACHELOR OF COMPUTER APPLICATION (B.C.A.)

DETAILED SYLLABUS

THIRD SEMSTER

COURSE CODE : BCA – S205

Elements of Statistics

UNIT-I

Population, Sample and Data Condensation

Definition and scope of statistics, concept of population and simple with Illustration, Raw data, attributes and variables, classification, frequency distribution, Cumulative frequency distribution.

UNIT-II

Measures of Central Tendency

Concept of central Tendency, requirements of a good measures of central tendency, Arithmetic mean, Median, Mode, Harmonic Mean, Geometric mean for grouped and ungrouped data.

UNIT-III

Measures of Dispersion:

Concept of dispersion, Absolute and relative measure of dispersion, range variance, Standard deviation, Coefficient of variation.

UNIT-IV

Permutations and Combinations

Permutations of 'n' dissimilar objects taken 'r' at a time (with or without repetitions). nPr = n!/(n-r) !(without proof). Combinations of 'r' objects taken from 'n' objects. nCr = n!/(r!(n-r)!) (without proof) . Simple examples, Applications.

UNIT-V

Sample space, Events and Probability

Experiments and random experiments, Ideas of deterministic and non-deterministic experiments; Definition of sample space, discrete sample space, events; Types of events, Union and intersections of two or more events, mutually exclusive events, Complementary event, Exhaustive event; Simple examples.

Classical definition of probability, Addition theorem of probability without Proof (upto three events are expected). Definition of conditional probability Definition of independence of two events, simple numerical problems.

UNIT-VI

Statistical Quality Control

Introduction, control limits, specification limits, tolerance limits, process and product control; Control charts for X and R; Control charts for number of defective {n-p chart}, control charts for number of defects {c - chart}

Referential Books:

1. S.C.Gupta - Fundamentals of statistics - Sultan chand & sons, Delhi.
2. D.N.Elhance - Fundamentals of statistics - Kitab Mahal, Allahabad.
3. Montogomery D.C. – Statistical Quality Control - John Welly and Sons
4. Goon, Gupta And Dasgupta - Fundamentals of statistics - The world press private ltd. , Kolkata.
5. Hogg R.V. and Craig R.G. – Introduction to mathematical statistics Ed 4 {1989} – Macmillan Pub. Co. Newyork.
6. Gupta S.P. – Statistical Methods , Pub – Sultan Chand and sons New Delhi

BACHELOR OF COMPUTER APPLICATION (B.C.A.)

DETAILED SYLLABUS

THIRD SEMSTER

COURSE CODE : BCA – S206 (a)

Computer Laboratory and Practical Work of OOPS

Practical will be based on Paper Object Oriented Programming:

Covers UNIT-II, UNIT-III, UNIT-IV, UNIT-V of Syllabus

BACHELOR OF COMPUTER APPLICATION (B.C.A.)

DETAILED SYLLABUS

THIRD SEMSTER

COURSE CODE : BCA – S206 (b)

Computer Laboratory and Practical Work of DS

Practical will be based on Paper Data Structure:

Covers UNIT-III, UNIT-IV, UNIT-V, UNIT-VI of Syllabus

BACHELOR OF COMPUTER APPLICATION (B.C.A.)

DETAILED SYLLABUS

FOURTH SEMSTER

COURSE CODE : BCA – S207

Computer Graphics & Multimedia Application

UNIT-I

Introduction: The Advantages of Interactive Graphics, Representative Uses of Computer Graphics, Classification of Application Development of Hardware and software for computer Graphics, Conceptual Framework for Interactive Graphics, Overview, Scan: Converting Lines, Scan Converting Circles, Scan Converting Ellipses.

UNIT-II

Hardcopy Technologies, Display Technologies, Raster-Scan Display System, Video Controller, Random-Scan Display processor, Input Devices for Operator Interaction, Image Scanners, Working exposure on graphics tools like Dream Weaver, 3D Effects etc.

Clipping

Southland- Cohen Algorithm, Cyrus-Beck Algorithm, Midpoint Subdivision Algorithm.

UNIT-III

Geometrical Transformation

2D Transformation, Homogeneous Coordinates and Matrix Representation of 2D Transformations, composition of 2D Transformations, the Window-to-Viewport Transformations, Introduction to 3D Transformations Matrix.

UNIT-IV

Representing Curves & Surfaces

Polygon meshes parametric, Cubic Curves, Quadric Surface;

Solid Modeling

Representing Solids, Regularized Boolean Set Operation primitive Instancing Sweep Representations, Boundary Representations, Spatial Partitioning Representations and Constructive Solid Geometry Comparison of Representations.

UNIT-V

Introductory Concepts: Multimedia Definition, CD-ROM and the multimedia highway, Computer Animation (Design, types of animation, using different functions)

UNIT-VI

Uses of Multimedia, Introduction to making multimedia – The stage of Project, hardware & software requirements to make good multimedia skills and Training opportunities in Multimedia Motivation for Multimedia usage.

Referential Books:

1. Foley, Van Dam, Feiner, Hughes, Computer Graphics Principles& practice,2000.
2. D.J. Gibbs & D.C. Tsichritzs: Multimedia programming Object Environment& Frame work , 2000
3. Ralf Skinmeiz and Klana Naharstedt, Multimedia: computing, Communication and Applications, pearson, 2001
4. D.Haran & Baker. Computer Graphics Prentice Hall of India,1986

BACHELOR OF COMPUTER APPLICATION (B.C.A.)

DETAILED SYLLABUS

FOURTH SEMSTER

COURSE CODE : BCA – S208

Operating System

UNIT-I

Introduction, What is an operating system, Simple Batch Systems, Multi-programmed Batch systems, Time- Sharing Systems, Personal – Computer Systems, Parallel systems, Distributed systems, Real- Time Systems**.**

Memory Management: Background, Logical versus physical Address space, swapping, Contiguous allocation, Paging, Segmentation

Virtual Memory: Demand Paging, Page Replacement, Page- replacement Algorithms, Performance of Demand Paging, Allocation of Frames, Thrashing, Other Considerations

UNIT-II

Processes: Process Concept, Process Scheduling, Operation on Processes.

CPU Scheduling: Basic Concepts, Scheduling Criteria, Scheduling Algorithms, Multiple – Processor Scheduling.

Process Synchronization: Background, The Critical – Section Problem, Synchronization Hardware, Semaphores, Classical Problems of Synchronization

UNIT-III

Deadlocks: System Model, Deadlock Characterization, Methods for Handling Deadlocks, Deadlock prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock

UNIT-IV

Device Management: Techniques for Device Management, Dedicated Devices, Shared Devices, Virtual Devices; Input or Output Devices, Storage Devices, Buffering,

Secondary Storage Structure: Disk Structure, Disk Scheduling, Disk Management, Swap- Space Management, Disk Reliability.

UNIT-V

Information Management: Introduction, A Simple File system, General Model of a File System, Symbolic File System, Basic File System, Access Control Verification, Logical File System, Physical File system File – System Interface; File Concept, Access Methods, Directory Structure, Protection, Consistency Semantics File – System Implementation: File – System Structure, Allocation Methods, Free- Space Management.

Referential Books:

1. Silbersachatz and Galvin, " Operating System Concepts", Person, 5th Ed. 2001
2. Madnick E., Donovan J., " Operating Systems:,Tata McGraw Hill,2001
3. Tannenbaum, "Operating Systems", PHI, 4th Edition, 2000

BACHELOR OF COMPUTER APPLICATION (B.C.A.)

DETAILED SYLLABUS

FOURTH SEMSTER

COURSE CODE : BCA – S209

Software Engineering

UNIT-I

Software Engineering: Definition and paradigms, A generic view of software engineering.

UNIT-II

Requirements Analysis: Statement of system scope, isolation of top level processes and entitles and their allocation to physical elements, refinement and review.
Analyzing a problem, creating a software specification document, review for correctness, consistency, and completeness.

UNIT-III

Designing Software Solutions: Refining the software Specification; Application of fundamental design concept for data, architectural and procedural designs using software blue print methodology and object oriented design paradigm; Creating design document: Review of conformance to software requirements and quality.

UNIT-IV

Software Implementation: Relationship between design and implementation, Implementation issues and programming support environment, Coding the procedural design, Good coding style and review of correctness and readability.

UNIT-V

Software Maintenance: Maintenance as part of software evaluation, reasons for maintenance, types of maintenance (Perceptive, adoptive, corrective), designing for maintainability, techniques for maintenance.

UNIT-VI

Comprehensive examples using available software platforms/case tools, Configuration

Management.

Referential Books:

1. K.K.Aggarwal & Yogesh Singh "Software engineering", 2nd Ed., New Age International 2005.
2. I.Sommerville, "Software Engineering", Addison Wesley, 2002.
3. James Peter, W. Pedrycz, "Software Engineering: An Engineering Approach" John Wiley & Sons.

BACHELOR OF COMPUTER APPLICATION (B.C.A.)

DETAILED SYLLABUS

FOURTH SEMSTER

COURSE CODE : BCA – S210

Optimization Techniques

UNIT-I

Linear programming

Central Problem of linear Programming various definitions included Statements of basic theorem and also their properties, simplex methods, primal and dual simplex method, transport problem, tic-tac problem, and its solution. Assignment problem and its solution. Graphical Method Formulation, Linear Programming Problem.

UNIT-II

Queuing Theory

Characteristics of queuing system, Classification of Queuing Model Single Channel Queuing Theory, Generalization of steady state M/M/1 queuing models(Model-I, Model-II).

UNIT-III

Replacement Theory

Replacement of item that deteriorates replacement of items that fail. Group replacement and individual replacement.

UNIT-IV

Inventory Theory

Cost involved in inventory problem- single item deterministic model economics long size model without shortage and with shorter having production rate infinite and finite.

UNIT-V

Job Sequencing

Introduction, solution of sequencing problem Johnson s algorithm for n jobs through 2 machines

Referential Books:

1. Gillet B.E. “Introduction to Operation Research”
2. Taha,H.A. “Operation Research - an introduction”
3. Kanti Swarup “Operation Research”
4. S.D.Sharma “Operation Research”
5. Hira & Gupta “Operation Research”

BACHELOR OF COMPUTER APPLICATION (B.C.A.)

DETAILED SYLLABUS

FOURTH SEMSTER

COURSE CODE : BCA – S211

Mathematics-III

UNIT-I

COMPLEX VARIABLES: Complex Number System, Algebra of Complex Numbers, Polar Form, Powers and Roots, Functions of Complex Variables, Elementary Functions, Inverse Trigonometric Function.

UNIT-II

SEQUENCE, SERIES AND CONVERGENCE: Sequence, Finite and Infinite Sequences, Monotonic Sequence, Bounded Sequence, Limit of a Sequence, Convergence of a Sequence, Series, Partial Sums, Convergent Series, Theorems on Convergence of Series (statement, alternating series, conditional convergent), Leibnitz Test, Limit Comparison Test, Ratio Test, Cauchy's Root Test, Convergence of Binomial and Logarithmic Series, Raabe's Test, Logarithmic Test, Cauchy's Integral Test (without proof)

UNIT-III

VECTOR CALCULUS: Differentiation of Vectors, Scalar and Vector Fields, Gradient, Directional Derivatives, Divergence and Curl and their Physical Meaning.

UNIT-IV

FOURIER SERIES: Periodic Functions, Fourier series, Fourier Series of Even and Odd Functions, Half Range Series.

UNIT-V

ORDINARY DIFFERENTIAL EQUATIONS OF FIRST ORDER: Variable - Separable Method, Homogeneous Differential Equations, Exact Differential Equations, Linear Differential Equations, Bernoulli's Differential Equations, Differential Equations of First Order and First Degree by Integrating Factor.

UNIT-VI

ORDINARY DIFFERENTIAL EQUATIONS OF SECOND ORDER: Homogenous Differential Equations with Constant Coefficients, Cases of Complex Roots and Repeated. Roots, Differential Operator, Solutions by Methods of Direct Formulae for Particular Integrals, Solution by Undetermined Coefficients, Cauchy Differential Equations, (only Real and Distinct Roots) Operator Method for Finding Particular Integrals, (Direct Formulae).

Referential Books:

1. A.B. Mathur and V.P. Jaggi, "Advanced Engineering Mathematics", Khanna Publishers, 1999.
2. 2. H.K. Dass, "Advanced Engineering Mathematics", S. Chand & Co., 9th Revised Ed.

BACHELOR OF COMPUTER APPLICATION (B.C.A.)

DETAILED SYLLABUS

FOURTH SEMSTER

COURSE CODE : BCA – S212

Computer Laboratory and Practical Work of Computer Graphics & Multimedia Application

Practical will be based on Paper Computer Graphics & Multimedia Application:

Covers UNIT-II, UNIT-III, UNIT-V of Syllabus

BACHELOR OF COMPUTER APPLICATION (B.C.A.)

DETAILED SYLLABUS

FIFTH SEMSTER

COURSE CODE : BCA – S301

Introduction to DBMS

UNIT-I

Introduction: Characteristics of database approach, data models, DBMS architecture and data independence.

UNIT-II

E-R Modeling: Entity types, Entity set, attribute and key, relationships, relation types, roles and structural constraints, weak entities, enhanced E-R and object modeling, Sub classes; Super classes, inheritance, specialization and generalization.

UNIT-III

File Organization: Indexed sequential access files; implementation using B & B++ trees, hashing, hashing functions, collision resolution, extendible hashing, dynamic hashing approach implementation and performance.

UNIT-IV

Relational Data Model: Relational model concepts, relational constraints, relational alzebra **SQL:** SQL queries, programming using SQL.

UNIT-V

EER and ER to relational mapping: Data base design using EER to relational language.

UNIT-VI

Data Normalization: Functional Dependencies, Normal form up to 3rd normal form.
Concurrency Control: Transaction processing, locking techniques and associated, database recovery, security and authorization. Recovery Techniques, Database Security

Referential Books:

1. Abraham Silberschatz, Henry Korth, S.Sudarshan, “Database Systems Concepts”, 4th Edition, McGraw Hill, 1997.

2. Jim Melton, Alan Simon, “Understanding the new SQL: A complete Guide”, Morgan Kaufmann Publishers, 1993.
3. A.K.Majumdar, P. Bhattacharya, “Database Management Systems”, TMH, 1996.
4. Bipin Desai, “An Introduction to database systems”, Galgotia Publications, 1991.

BACHELOR OF COMPUTER APPLICATION (B.C.A.)

DETAILED SYLLABUS

FIFTH SEMSTER

COURSE CODE : BCA – S302

Java Programming and Dynamic Webpage Design

UNIT-I

Java Programming: Data types, control structured, arrays, strings, and vector, classes (inheritance, package, exception handling) multithreaded programming.

UNIT-II

Java applets, AWT controls (Button, Labels, Combo box, list and other Listeners, menu bar) layout manager, string handling (only main functions)

UNIT-III

Networking (datagram socket and TCP/IP based server socket) event handling, JDBC: Introduction, Drivers, Establishing Connection, Connection Pooling.

UNIT-IV

HTML: use of commenting, headers, text styling, images, formatting text with <FONT>, special characters, horizontal rules, line breaks, table, forms, image maps, <META> tags, <FRAMESET> tags, file formats including image formats.

UNIT-V

Java Servlets: Introduction, HTTP Servlet Basics, The Servlet Lifecycle, Retrieving Information, Sending HTML Information, Session Tracking, Database Connectivity

UNIT-VI

Java Server Pages: Introducing Java Server Pages, JSP Overview, Setting Up the JSP Environment, Generating Dynamic Content, Using Custom Tag Libraries and the JSP Standard Tag Library, Processing Input and Output.

Referential Books:

1. Patrick Naughton and Herbertz Schildt, "Java-2 The Complete Reference" 199, TMH.
2. Shelley Powers, "Dynamic Web Publishing" 2nd Ed. Techmedia, 1998.
3. Ivor Horton, "Beginning Java-2" SPD Publication
4. Jason Hunter, "Java Servlet Programming" O'Reilly
5. Shelley Powers, "Dynamic Web Publishing" 2nd Ed. Techmedia, 1998
6. Hans Bergsten, "Java Server Pages", 3rd Ed. O'reilly

BACHELOR OF COMPUTER APPLICATION (B.C.A.)

DETAILED SYLLABUS

FIFTH SEMSTER

COURSE CODE : BCA – S303

Computer Network

UNIT-I

Basic Concepts: Components of data communication, distributed processing, standards and organizations. Line configuration, topology, Transmission mode, and categories of networks.

OSI and TCP/IP Models: Layers and their functions, comparison of models. Digital Transmission: Interfaces and Modems: DTE-DCE Interface, Modems, Cable modems.

UNIT-II

Transmission Media: Guided and unguided, Attenuation, distortion, noise, throughput, propagation speed and time, wavelength, Shannon capacity, comparison of media.

UNIT-III

Telephony: Multiplexing, error detection and correction: Many to one, One to many, WDM, TDM, FDM, Circuit switching, packet switching and message switching.

Data link control protocols: Line discipline, flow control, error control, synchronous and asynchronous protocols, character and bit oriented protocols, Link access procedures.

Point to point controls: Transmission states, PPP layers, LCP, Authentication, NCP.
ISDN: Services, Historical outline, subscriber's access, ISDN Layers and broadcast ISDN.

UNIT-IV

Devices: Repeaters, bridges, gateways, routers, The Network Layer; Design issues, Routing algorithms, Congestion control Algorithms, Quality of service, Internetworking, Network-Layer in the internet.

UNIT-V

Transport and upper layers in OSI Model: Transport layer functions, connection management, functions of session layers, presentation layer and application layer.

Referential Books:

1. A.S.Tanenbaum, "Computer Networks"; Pearson Education Asia, 4th Ed. 2003.
2. Behrouz A.Forouzan, "Data Communication and Networking", 3rd Ed. Tata McGraw Hill, 2004.
3. William stallings, "Data and computer communications", Pearson education Asia, 7th Ed., 2002.

BACHELOR OF COMPUTER APPLICATION (B.C.A.)

DETAILED SYLLABUS

FIFTH SEMSTER

COURSE CODE : BCA – S304

Numerical Methods

UNIT-I

Roots of Equations: Bisections Method, False Position Method, Newton's Raphson Method, Rate of convergence of Newton's method.

UNIT-II

Interpolation and Extrapolation : Finite Differences, The operator E, Newton's Forward and Backward Differences, Newton's dividend differences formulae, Lagrange's Interpolation formula for unequal Intervals, Gauss's Interpolation formula, Starling formula, Bessel's formula, Laplace-Everett formula.

UNIT-III

Numerical Differentiation Numerical Integration : Introduction, direct methods, maxima and minima of a tabulated function, General Quadratic formula, Trapezoidal rule, Simpson's One third rule, Simpson's three- eight rule.

UNIT-IV

Solution of Linear Equation: Gauss's Elimination method and Gauss's Siedel iterative method.

UNIT-V

Solution of Differential Equations: Euler's method, Picard's method, Fourth-order Ranga – Kutta method.

Referential Books:

1. Scarbourogh, "Numerical Analysis".
2. Gupta & Bose S.C. "Introduction to Numerical Analysis, "Academic Press, Kolkata, 3. S.S.Shashtri, " Numerical Analysis", PHI

BACHELOR OF COMPUTER APPLICATION (B.C.A.)

DETAILED SYLLABUS

FIFTH SEMSTER

COURSE CODE : BCA – S305(a)

Minor Project

Evaluation will be based on Summer Training held after fourth semester and will be Conducted by the college committee only.

BACHELOR OF COMPUTER APPLICATION (B.C.A.)

DETAILED SYLLABUS

FIFTH SEMSTER

COURSE CODE : BCA – S305(b)

Viva-Voice on Summer Training

The viva will be conducted based on summer training of four weeks after the end of fourth Semester and will be Conducted by the college committee only.

BACHELOR OF COMPUTER APPLICATION (B.C.A.)

DETAILED SYLLABUS

FIFTH SEMSTER

COURSE CODE : BCA – S306(a)

Computer Laboratory and Practical Work of DBMS

Practical will be based on Paper Data Base Management System : on UINT-IV converging the concept from UNIT-II to UNIT-VI of Syllabus

BACHELOR OF COMPUTER APPLICATION (B.C.A.)

DETAILED SYLLABUS

FIFTH SEMSTER

COURSE CODE : BCA – S306(b)

Computer Laboratory and Practical Work of Java Programming and Dynamic Webpage Design

Practical will be based on Paper Java Programming & Website Design : on Whole Syllabus

BACHELOR OF COMPUTER APPLICATION (B.C.A.)

DETAILED SYLLABUS

SIXTH SEMSTER

COURSE CODE : BCA – S307

Computer Network Security

UNIT-I

Introduction: Attack, Services and Mechanism, Model for Internetwork Security. Cryptography: Notion of Plain Text, Encryption, Key, Cipher Text, Decryption and cryptanalysis; Public Key Encryption, digital Signatures and Authentication.

UNIT-II

Network Security:

Authentication Application: Kerveros, X.509, Directory Authentication Service, Pretty Good Privacy, S/Mime.

UNIT-III

IP security Architecture: Overview, Authentication header, Encapsulating Security Pay Load combining Security Associations, Key Management.

UNIT-IV

Web Security: Requirement, Secure Socket Layer, Transport Layer Security, and Secure Electronic Transactions.

UNIT-V

Network Management Security: Overview of SNMP Architecutre-SMMPVI1 Communication Facility, SNMPV3.

UNIT-VI

System Security: Intruders, Viruses and Relate Threats, Firewall Design Principles. Comprehensive examples using available software platforms/case tools, Configuration Management.

Referential Books:

1. W. Stallings, Networks Security Essentials: Application & Standards, Pearson Education, 2000.
2. W.Stallings, Cryptography and Network Security, Principles and Practice, Pearson Education, 2000.

BACHELOR OF COMPUTER APPLICATION (B.C.A.)

DETAILED SYLLABUS

SIXTH SEMSTER

COURSE CODE : BCA – S308

Information System: Analysis Design & Implementation

UNIT-I

Overview of System Analysis and Design: Systems Development Life Cycle; concept and Models: requirements determination, logical design, physical design, test planning, implementation, planning and performance evaluation, communication, interviewing, presentation skills; group dynamics; risk and feasibility analysis; group based approaches, JAD, structures walkthroughs, and design and code reviews; prototyping; database design software quality metrics; application categories software package evaluation and acquisition.

UNIT-II

Information Requirement Analysis: Process modeling with physical logical data flow diagrams, data modeling with logical entity relationship diagrams.

UNIT-III

Developing a Proposal: Feasibility study and cost estimation.

System Design: Design of input and control, design of output and control, file design/database design, process, user interface design, prototyping; software constructors; documentation.

UNIT-IV

Application Development Methodologies and CASE tools: Information engineering structured system analysis and design, and object oriented methodologies for application development data modeling, process modeling, user interface design, and prototyping, use of computer aided software engineering (CASE) tools in the analysis design and implementation of information systems.

UNIT-V

Design and Implementation on OO Platform: Object oriented analysis and design through object modeling technique, object modeling, dynamic modeling and functional object oriented design and object oriented programming systems for implementation, object oriented data bases.

UNIT-VI

Managerial issues in Software Projects: Introduction to software markets; planning of software projects, size and cost estimates; project scheduling; measurement of software quality and productivity, ISO and capability maturity models for organizational growth.

Referential Books:

1. I.T.Haryszkiewycz, Introduction of System Analysis and Design, Pearson Education, (PHI) 1998.
2. V.Rajaraman, Analysis and Design of Information System, Pearson Education, 1991.
3. J.A.Senn, “Analysis and Design of Information Systems”
4. J.K.Whiten., L.D.Bentley, V.M.Beslow, “System Analysis and Design Methods”, (Galgotia Publications Pvt.Ltd.) 1994

BACHELOR OF COMPUTER APPLICATION (B.C.A.)

DETAILED SYLLABUS

SIXTH SEMSTER

COURSE CODE : BCA – S309

E-Commerce

UNIT-I

Introduction to E-Commerce: The Scope of Electronic Commerce, Definition of Electronic Commerce, Electronic E-commerce and the Trade Cycle, Electronic Markets, Electronic Data Interchange, Internet Commerce, E-Commerce in Perspective.

Business Strategy in an Electronic Age: Supply Chains, Porter's Value Chain Model, Inter Organizational Value Chains, Competitive Strategy, Porter's Model, First Mover Advantage Sustainable Competitive Advantage, Competitive Advantage using E -Commerce, Business Strategy, Introduction to Business Strategy, Strategic Implications of IT, Technology, Business Environment, Business Capability, Exiting Business Strategy, Strategy Formulation & Implementation Planning, E-Commerce Implementation, E-Commerce Evaluation.

UNIT-II

Business-to-Business Electronic Commerce: Characteristics of B2B EC, Models of B2B Ec, Procurement Management Using the Buyer's Internal Marketplace, Just in Time Delivery, Other B2B Models, Auctions and Services from Traditional to Internet Based EDI, Intergration with Back-end Information System, The Role of Software Agents for B2B EC, Electronic marketing in B2B, Solutions of B2B EC, Managerial Issues, Electronic Data Interchange (EDI), EDI: The Nuts and Bolts, EDI & Business.

UNIT-III

Internet and Extranet : Automotive Network Exchange, The Largest Extranet, Architecture of the Internet, Intranet and Extranet, Intranet software, Applications of Intranets, Intranet Application Case Studies, Considerations in Intranet Deployment, The Extranets, The structures of Extranets, Extranet products &

services, Applications of Extranets, Business Models of Extranet Applications, Managerial Issues.

Electronic Payment Systems : Is SET a failure, Electronic Payments & Protocols, Security Schemes in Electronic payment systems, Electronic Credit card system on the Internet, Electronic Fund transfer and Debit cards on the Internet, Stored – value Cards and E- Cash, Electronic Check Systems, Prospect of Electronic Payment Systems, Managerial Issues.

UNIT-IV

Public Policy: From Legal Issues to Privacy : EC- Related Legal Incidents, Legal Incidents, Ethical & Other Public Policy Issues, Protecting Privacy, Protecting Intellectual Property, Free speech, Internet Indecency & Censorship, Taxation & Encryption Policies, Other Legal Issues: Contracts, Gambling & More, Consumer & Seller Protection In EC.

UNIT-V

Infrastructure For EC : It takes more than Technology, A Network Of Networks, Internet Protocols, Web- Based client/ Server, Internet Security, selling on the web, Chatting on the Web, Multimedia delivery, Analyzing Web Visits, Managerial Issues.

Referential Books:

1. David Whiteley, " E-Commerce", Tata McGraw Hill, 2000
2. Eframi Turban, Jae Lee, David King, K. Michale Chung, "Electronic Commerce", Pearson Education, 2000

BACHELOR OF COMPUTER APPLICATION (B.C.A.)

DETAILED SYLLABUS

SIXTH SEMSTER

COURSE CODE : BCA – S310

Knowledge Management

UNIT-I

Business Intelligence and Business Decisions: Modeling Decision Process; Decision support systems; Group decision support and Groupware Technologies.

UNIT-II

Executive Information and support Systems: Business Expert System and AI, OLTO & OLAP; Data Warehousing; Data Marts, Data Warehouse architecture; Tools for data warehousing.

UNIT-III

Multi- Dimensional analysis: Data mining and knowledge discovery; Data mining and Techniques; Data mining of Advance Databases.

UNIT-IV

Knowledge Management Systems: Concept and Structure KM systems, techniques of knowledge management appreciation & limitation.

Referential Books:

1. Decision support system, EIS, 2000
2. W.H.Inmon, "Building Data Warehousing", Willey, 1998.
3. Han, Jiawei, Kamber, Michelinal, " Data Mining Concepts & Techniques", Harcourt India, 2001

BACHELOR OF COMPUTER APPLICATION (B.C.A.)

DETAILED SYLLABUS

SIXTH SEMSTER

COURSE CODE : BCA – S311

Major Project

Evaluation will be based on held after fourth semester and will be Conducted by the college committee only.

BACHELOR OF COMPUTER APPLICATION (B.C.A.)

DETAILED SYLLABUS

SIXTH SEMSTER

COURSE CODE : BCA – S312

Presentation/Seminar based on Major Project

Presentation/Seminar based on Major Project will be evaluated by external examiner only.

M.Sc. Biochemistry Syllabus
Under credit system at the Department of Biochemistry
Dr. Bhimrao. Ambedkar University, Agra

Program Outcomes (POS):

Department Name	**Programme Name**	**POs**	**PSOs**
Biochemistry	MSc	**PROGRAMME OUTCOME(POs)** PG biochemistry will be able to achieve 1. To develop analytical and critical-thinking skills that allow independent exploration of biological phenomena through the scientific method. 2. To prepare students for future careers in the various fields of biochemistry such as academic and research institution. c. The foremost objective of the programme is to empower students with clear understanding of the basic concepts of biochemistry and provide them knowledge of the recent advances so that they can independently assess the vast research scope in the field. d. Identification and Differential Diagnosis: To acquire biochemist position in leading hospitals and scientist position in industries. e. The programme includes details of bio molecules, metabolism, tools and techniques molecular biology, clinical biochemistry, proteins & enzymes, immunology, cell biology, genetic engineering, clinical biochemistry, nanotechnology and bioinformatics to make the study of living system more comprehensive with in depth knowledge yet interesting which is the need of hour.. f. The practical courses have been designed to equip the students with the laboratory skills in biochemistry. The program offers students the knowledge and skill base that would enable them to undertake advanced studies in biochemistry and related areas or in multidisciplinary areas that involve biochemistry. g. The students will gain domain knowledge and know-how for successful career in academia, industry and research. Moreover, students will learn ever evolving professional demands by	**PROGRAMME SPECIFIC OUTCOME (PSOs)** PG biochemistry will be able to achieve **National Education Policy 2020 adopted (CBCS syllabus)** with a combination of general and specialized education is well designed and very promising where the core course would help to enrich the subject knowledge of the students and generic electives make integration among various interdisciplinary courses. **PSO1**: Know the basics of anti oxidative defense system in plants. Understand the importance secondary metabolites, fundamentals of photosynthesis, metabolism of nitrogen, polysaccharides and molecular mechanisms of signalization and regulation of plant hormones. PSO2: To demonstrate the knowledge of biochemical processes from the cellular and molecular aspects. Exhaustive study of Cell Signaling pathways, secondary messengers. Study of cell theory, Cell organelles, Ultrastructure, roles of cell organelles. PSO3: Classify biomolecules with suitable examples and differentiate between their features. Analyze the interrelationship between biomolecules and their derivatives. Assemble and significance in biochemical reactions and characterization of biomolecules. Articulate concepts, parameters, mechanism and applications of different types of chromatography Illustrate the types of electrophoresis, applications and principles underlying the techniques NMR, CD, ORD. Specify the working mechanisms and applications of basic spectroscopic techniques. PSO4 : To learn principal concepts about biostatistics,

		developing ethical inter personal and team skills.	To adapt skill in statistical technology like ANOVA, SD, SE, Corelation, Regrassion To use computers in data acquisition and processing and use available software as a tool in data analysis and Bioinformatics.. PSO5: The of the course is learning and understanding the fundamentals of molecular biology like nucleic acid as genetic material, replication, gene organization and its regulation etc.. PSO6: To apprise the students about components associated with immune system and molecular mechanism of their working. The students will be able to describe the roles of the immune system in both maintaining health and contributing to disease. PSO7: To apply the concepts of applications of enzyme in industry and clinical field. PSO8: To study the free energy and entropy. To understand various metabolic pathway. PSO9: The students will be able to understand and predict the various metabolic reactions in microbial cell, structure of viruses and eubacteria. To understand the role of microorganisms in domestic and industrial sewage. PSO10: To relate the calorific and nutritive value of foods and describe Physiological role of nutrients. To design the types of balanced diet for all age groups. To investigate the role of vitamins and minerals in maintaining proper health. PSO11: To assess the changes in various metabolic and clinical abnormalities. To detect various biochemical parameters in the diagnosis of diseases. To find the clinical manifestations in kidney function and liver function test. PSO12. To get familiarized about gene libraries construction and to perform blotting. To have in-depth knowledge, DNA sequencing, rDNA

			technology, cloning, gene therapy and their applications. PSO13. To get knowledge on basic pharmaceutical industry, therapeutic agents, mechanism of drug action and the principle of physico-chemical properties of drugs. To gain the knowledge the process involved in manufacturing of drugs, analyse the special requirements, reaction process and applications. PSO14: To learn about nanomaterial and nanoscience, PCR and RFLP. To get deep insight of Ti plasmid, Transgenic plants and their applications and basics of nanobiotechnology. PSO15: To get deep knowledge of various physiological functions of the human body and hematology PSO16: Understand environmental health and its hazards. Effect of Pesticides, insecticides and solution to the pollution. POS17: To learn the types of microarray chips and their production, gene therapy for human diseases, protein crystallization, MALDI-TOF and human genome project and protein- protein interaction. PSO18: To gain knowledge of co-transcriptional processing, translation in prokaryotes and eukaryotes, chromatin remodelers, alternative splicing, histone mRNA processing and concept of operon. PSO19: To attain a remarkable understanding of diabetes, thyroid disorders and renal and liver function tests along with biochemical aspects of hematology.

M.Sc. Biochemistry Syllabus
Under credit system at the Department of Biochemistry
Dr. Bhimrao. Ambedkar University, Agra

Semester	**Papers**	Marks		**Total**	**Credit**
Semester I Course Code		CIE	End Semester examination		
BC 101C	Plant Biochemistry	25	75	100	4
BC 102C	Cell Biology and Cell Signalling	25	75	100	4
BC 103C	Biomolecules and Bioinstrumentation	25	75	100	4
BC 104C	Biostatistics and Computer Applications	25	75	100	4
BC 105	Practical			100	4
	IndustrialTraining/Survey/Research Project				
Total				**500**	**20**
Semester	**Papers**	Marks		**Total**	**Credit**
Semester II Course Code		CIE	End Semester examination		
BC 201C	Essential of Molecular Biology	25	75	100	4
BC 202C	Immunology	25	75	100	4
BC 203C	Advanced Enzymology	25	75	100	4
BC 204C	Intermediary Metabolism	25	75	100	4
BC 205	Practical			100	
	Industrial Training/ Survey/Research Project			200	8
	Minor	25	75	100	4
	Total		800	32	
Semester	**Papers**	Marks		**Total**	**Credit**
Semester III Course Code		CIE	End Semester examination		
BC 301C	Microbial Physiology and Biochemistry	25	75	100	4
BC 302C	Nutritional Biochemistry	25	75	100	4
BC 303C	Clinical Biochemistry and Biosafety	25	75	100	4
BC 304E	Genetic Engineering	25	75	100	4
BC 305E	Pharmaceutical biochemistry				
BC 305	Practical		100	100	4
	Industrial Training/ Survey/Research Project				
Total				500	20
Semester	**Papers**	Marks		**Total**	**Credit**
Semester IV Course Code		CIE	End Semester examination		
BC 401C	Applied Biotechnology	25	75	100	4
BC 402C	Human Physiology	25	75	100	4
BC 403E	Environmental Biochemistry	25	75	100	4
BC 404E	Genomics and Proteomics				
BC 405E	Gene Expression and Regulation	25	75	100	4

BC 406E	Medical Biochemistry				
BC 407	Practical		100	100	4
	Industrial Training/ Survey/Research Projet		200	200	8
Total				700	28

Skill development | Entrepreneurship | Employability

M.Sc. BIOCHEMISTRY
SEMESTER – FIRST
BC-101 C (Core Course)
PLANT BIOCHEMISTRY

Course Outcomes:

On the completion of the course, students will be able to:		Level
CO1	Students will be taught specific aspects of Plant Biochemistry that are not covered under general biochemistry	L1
CO2	The course has been a specialty of the Department of Biochemistry and is designed to give the students comprehensive knowledge of molecular aspects of plant Biology.	L2
CO3	Preparing a strong platform for a research career in the area	L2
CO4	In this course, students will extend their knowledge of Biochemistry fundamentals and will learn about important metabolic processes taking place in plants. Acquire a detailed knowledge about photosynthesis, metabolism of polysaccharides, metabolism of nitrogen compounds and molecular mechanisms of signalization and regulation	L2

(TOTAL CREDIT -04,END SEMESTER MARKS-75,CIE-25)

UNIT	Topic	No.of Lectures Hours 60
I	Structure and function of plant cell, cell wall, plasmodesmata, vacuoles, peroxisomes. Isolation of cell organelles, mechanism of the transport of water, inorganic and organic substances,Seed dormancy, growth and development.	15
II	Photosynthesis: structure of organelles involved in photosynthesis in plants and bacteria, photo system I, II and their location, mechanism of quantum captures and energy transfers between photo system, reduction of CO_2, C_3, C_4 and CAM metabolism regulation of photosynthesis.Photorespiration and its significance.	15
III	Biological nitrogen fixation: mechanism of nitrate uptake and reduction ammonia assimilation, sulphate uptake and transport. Mineral nutrition: micronutrients, macronutrients and their biological role in plants.	15hrs

IV	Secondary plant metabolites: biosynthesis of tannins, alkaloids (pyrrolidine, piperidine, coniine, quinolinate), flavonoids and surface waxes and their functions.Antioxidative defense system in plants.Plant hormones: Mode of action of auxins, gibberellins, cytokinins, ethylene, abscissic acid	15hrs

Reference Books

Plant Biochemistry, Goodwin Mercer

Plant Physiology, Salisbury Ross

Biochemistry and Molecular Biology of Plants, by Buchanan

Plant Biochemistry and Molecular Biology, by Lea and Leegood Plant Biochemistry, by Dey and Harborne

Course Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5	PSO
CO1	-												3					
CO2			2															
CO3																		
CO4													3	3				

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

M.Sc. BIOCHEMISTRY
SEMESTER – FIRST
BC-102 C (Core Course)
CELL BIOLOGY AND CELL SIGNALLING

On the completion of the course, students will be able to:		Level
CO1	Learn about structural organization of prokaryotic and eukaryotic cells, ultra structure and functions of cell organelles.	L1
CO2	Understand about cell division: mitosis and meiosis; Cell cycle: check points, role of cyclin and cyclin dependent kinases in cell cycle regulation	L2
CO3	Acquire knowledge about basics of signal transduction	L2
CO4	Understand about protein trafficking in cells, Protein sorting, vesicular transport and protein targeting.	L2

(TOTAL CREDIT -04,END SEMESTER MARKS-75,CIE-25)		
UNIT	Topic	No.of Lectures Hours 60
I	Cell Membrane: Physicochemical Properties, Molecular Organization – asymmetrical organization of lipids, proteins and carbohydrates and functions.Transport across membranes: Types of transport (simple diffusion, passive-facilitated diffusion), active transport – primary and secondary group translocation, transport ATPases (V type, F type, P type, ABC type).	15hrs
II	Cell classification, cell variability (size, shape, complexity, and function). Structural organization of prokaryotic and eukaryotic cell. The ultrastructure of nucleus, mitochondria, endoplasmic reticulum (rough and smooth), Golgi apparatus, lysosomes and their function.The cytoskeleton: microtubules and microfilaments.The extra cellular matrix: collagen.	15hrs
III	Cell–cycle: phases of cell cycle, cell cycle check points, CdK, cyclins, MPF, p53, wait signal,Apoptosis. Cell division by mitosis and meiosis.Biochemistry of cancer: characteristics of cancer cell, carcinogenesis, carcinogens, oncogenes and tumor suppressor	15hrs

	genes.	
IV	Cell signaling: Forms of intracellular signaling, hormone and their receptors (steroid and plant hormones) Pathways of intracellular signal transduction: c-AMP pathway, c-GMP pathway, phospholipids and Ca^{++} Ras, Raf and MAP kinase pathway JAK/STAT pathway	15hrs

Reference Books

Molecular Biology of the Cell, Alberts, *et al*
Molecular Cell Biology, Lodish, et al
Cell and Molecular Biology: Concepts and Experiments, Gerald Karp
The Cell: A Molecular Approach, G.M. Cooper
The Word of the Cell, Becker *et al*
Cell Proliferation and Apoptosis, Hughes and Mehnet
Essential Cell Biology, Alberts *et al*
Biochemistry and Molecular Biology of Plants, Buchanan *et al*
Harpers Biochemistry Murray *et al*

Course Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5	PSO
CO1																		
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO3																		
CO4																		

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

M.Sc. BIOCHEMISTRY
SEMESTER – FIRST
BC-103 C (Core Course)
BIOMOLECULES AND BIOINSTRUMENTATION
(TOTAL CREDIT -04, END SEMESTER MARKS-75,CIE-25)

On the completion of the course, students will be able to:		Level
CO1	The knowledge of the structure of biomolecules, gives an understanding of their physical and chemical properties and the basis of their functions in living organisms.	L1
CO2	It prepares students for more advanced studies in Biochemistry.	L2
CO3	The course will help students to acquaint with basic instrumentation,	L2
CO4	Principle and procedure of various sophisticated instruments like UV-visible spectroscopy, different types of centrifugation, chromatography, electrophoresis, NMR, CD, ORD in biological research..	L2

(TOTAL CREDIT -04,END SEMESTER MARKS-75,CIE-25)		
UNIT	Topic	No.of Lectures Hours 60
I	Carbohydrates: Classification, structure of carbohydrates (monosaccharides, disaccharides polysaccharides- homo- and hetero-polysaccharides). Lipids: Classification, structure, properties and functions of fatty acids, essential fatty acids, fats, phospholipids, sphingolipids, cerebrosides, steroids, bile acids, prostaglandins and lipoproteins.	15hrs
II	Amino acids: Structure, classification, abbreviation, properties and functions of amino acids. Proteins: Classification, structure and functions of proteins, Ramachandran plot, Protein Sequencing. Nucleic acids: Structure and function of nucleotides. Primary, secondary and tertiary structure of nucleic acids. DNA forms (single stranded DNA, A, B and Z DNA) syn and anti conformations. Types of RNA (m RNA, t RNA, rRNA, hn RNA, micro RNA).	15hrs

III	Spectroscopy: Concept of spectroscopy, Laws of Photometry, Beer-Lambert's Law. Instrumentation and application of UV, Visible, and IR, Raman spectroscopy. Radioisotope Techniques: Units and measurement of radioactivity. Use of radioisotopes in Biomedicine and research.Electron Microscopy: Transmission and scanning, freeze fracture techniques.	15hrs
IV	Electrophoresis: Moving boundary zonal electrophoresis, paper and gel electrophoresis, isoelectric focusing. Chromatography: Paper Chromatography, Thin Layer Chromatography (TLC), Ion exchange, gel filtration and affinity chromatography, High Pressure Liquid Chromatography (HPLC) – Normal & reverse phase.Centrifugation techniques and their application. subcellular fractionation.	15hrs

Reference Books

Principles of Biochemistry by Nelson, Cox and Lehninger

Biochemistry by G.Zubay

Biochemistry, DVoet and JG. Voet , J Wiley and Sons.

Physical Biochemistry: Applications to Biochemistry and Molecular Biology, D Freifilder, W.H. Freeman & Company.

Practical Biochemistry, Wilson & Walker.

Course Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5	PSO
CO1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

M.Sc. BIOCHEMISTRY
SEMESTER –FIRST
BC-104 C(Core Course)
BIOSTATISTICS AND COMPUTER APPLICATIONS

At the end of the course, a student should be able to

On the completion of the course, students will be able to:		Level
CO1	Define the principal concepts about biostatistics	L1
CO2	Recognize the definition of statistics, its subject and its relation with the other sciences in the field of research and skill based knowledge.	L2
CO3	Collect data relating to variable/variables which will be examined and calculate descriptive statistics from these data. Identify data relating to variable/variables.	L2
CO4	Understanding the basics of computers and computational data analysis which in-turn can be used for interpretation of data analysis Access various global bioinformatics centers such as NCBI, EBI and Genome Net etc	L2

(TOTAL CREDIT -04,END SEMESTER MARKS-75,CIE-25)		
UNIT	Topic	No.of Lectures Hours 60
I	Measures of central tendency (arithmetic mean, mode, median), measure of dispersion, standard deviation, coefficient of variance, group data and graphic methods, frequency & distribution. Probability: Definition of probability, multiplication, law of probability, addition, law of probability, random variable permutation & combination. binomial, normal & poisson distribution.	15hrs
II	Tests of significance hypothesis and errors, Student statistics- Population mean equal a specified value. Equality of two independent means, Equality of two means. Non-parametric test Chi square statistics, test of goodness of fit. Regression and correlation coefficient, partial & multiple correlation, Relationship between regression and correlation. Analysis of variance:- One way analysis.	15hrs
III	Computers: Basics of common application software packages for word processing (MS Word), spreadsheets (MS Excel) and presentation (MS Powerpoint). Introduction of Internet- LAN, MAN, WAN.	15hrs
IV	Introduction to Bioinformatics: Concepts of Bioinformatics, Accessing and retrieving sequence information from genome sequence databases, use of genome data, overview of comparative and functions genomics,	15hrs

	application of computers in Biochemistry.	

Reference Books

Biostatistical analysis, Zar, Pearson
Biostatistics,Daniel, Wiley
Biostatistics, Norman, Decker
Fundamentals of Bioinformatics, Irfan Ali Khan, Ukanz
Fundamentals of Biostatistics, Irfan A. Khan and Khanum, Ukaz Publication
Fundamentals of Computers, V. Rajaraman, Prentice-Hall India
A Handbook of Agricultural Statistics, S.R.S. Chandel, Lal Prakshan

Course Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5	PSO
CO1																1		
CO2						3										2		
CO3																3		
CO4																3		

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

M.Sc. BIOCHEMISTRY
SEMESTER –SECOND
BC-201 C (Core Course)
ESSENTIALS OF MOLECULAR BIOLOGY

Course Outcomes

On the completion of the course, students will be able to:		Level
CO1	Learn about nucleic acid as genetic information carriers, Possible modes of replication, and roles of helicase, primase, gyrase, topoisomerase, DNA Polymerase, DNA ligase, and Regulation of replicationDefine the principal concepts about biostatistics	L1
CO2	Understand the detailed mechanism and regulation of Eukaryotic DNA replication, along with Mitochondrial and Chloroplastic DNA Replication	L2
CO3	Learn about mechanism and regulation of transcription in prokaryotes along with Reverse transcription.	L2
CO4	Understanding about the classes of DNA sequences, Genome-wide and Tandem repeats, Retroelements, Transposable elements, Centromeres, Telomeres, Satellite DNA, Mini satellites, Microsatellites; Applications of satellite DNA and Split genes	L2

(TOTAL CREDIT -04,END SEMESTER MARKS-75,CIE-25)		
UNIT	Topic	**No.of Lectures Hours 60hrs**
I	Organization of Genetic materials in prokaryotes and Eukaryotes: Genetic material, Genome type, Size, Genome Organization - Structural Maintenance of Chromosomes (SMC) Protein, Eukaryotic Nucleosomes, Histones, Chromatin, Concept of Gene, mono-cistronic and poly-cistronic genes, Gene Structure with various functional units - replicon, muton, recon, C-value and C-value paradox; Unique sequences and Cot value, reassociation kinetics, Split genes: Exons and Introns.	15hrs
II	**Replication:** Modes of replication: Details of Meselson and Stahl experiment; Prokaryotic DNA replication:Origin and Initiation, elongation and termination; Roles, properties and mechanism of action of DnaA, Helicase, Primase, DNA gyrase,Topoisomerases,DNA Polymerases, DNA ligase, Leading and lagging strands; Okazaki fragments; RNA primers;Regulation of replication; Fidelity of replication; Viral replication, σ or Rolling circle replication in ϕX174 **DNA** damage and DNA repair**:** Types of DNA damages, Types of DNARepair systems, Photoreactivation.	15hrs
III	Eukaryotic DNA replication: Initiation, elongation and termination; Multiple replicons/initiation sites; Autonomously replicating sequence; Mechanism and significance of Origin recognition complex, Mini-chromosome maintenance proteins, DNA dependent DNA polymerases α, δ, ε, Nucleases, DNA	15hrs

	ligase and Telomeres in eukaryotic nuclear DNA replication; Regulation of eukaryotic DNA replication; Mitochondrial and Chloroplast DNA replication.	
IV	Transcription in prokaryotes: Initiation, elongation and termination; Prokaryotic promoter; weak and strong promoters, DNA dependent RNA polymerase: Physical properties, Templet strand, non-template strand, coding strand, Subunits, σ factor, its types and function; Recognition of promoter; Transcription bubble, Direction of Transcription; Abortive initiations; Promoter clearance; Elongation factor Gre and its role, Rho dependent and Rho independent termination of transcription; Sigma cycle; RNA - dependent DNA polymerase and Reverse transcription.	15hrs

Reference Books

Genes XI , by Benjamin Lewin
Biochemistry – J. David Rawn – Neil Patterson publication, NC.
Cell and Molecular Biology: Concepts and Experiments, by Gerald Karp
Transcriptional Regulation in Eukaryotes, by Carey and Smale
Translational control of gene Expression, by Sonenberg *et al*
Chromatin and Gene Regulation, by Turner
An Introduction to Genetic Analysis, by Griffiths *et al*
Genome, by T. A. Brown

Course Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5	PSO
CO1					2												3	
CO2					3												2	
CO3					2												3	
CO4					3												2	

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

M.Sc. BIOCHEMISTRY
SEMESTER –SECOND
BC-202 C(Core Course)
IMMUNOLOGY
(TOTAL CREDIT -04, END SEMESTER MARKS-75,CIE-25)

Course Outcomes

On the completion of the course, students will be able to:		Level
CO1	Learn the fundamental principles of immune response including molecular, biochemical and cellular basis of immune homeostasis.	L1
CO2	Aid in understanding various aspects of immunological response and how its triggered and regulated.	L2
CO3	Understand the rationale behind various assays used in immunodiagnostics of diseases and will be able to transfer knowledge of immunology in clinical perspective.	L2
CO4	Develop understanding of principles of Graft rejection, Auto immunity and Antibody based therapy,develop the capacity for problem-solving about immune responsiveness, knowledge of pathogenesis of diseases and designing of immunology based interventions for effective treatment	L2

(TOTAL CREDIT -04,END SEMESTER MARKS-75,CIE-25)		
UNIT	**Topic**	**No.of Lectures Hours 60**
I	Introduction to Immune System Memory, specificity, diversity, innate and acquired immunity, self Vs non-self discrimination. Structure and functions of primary and secondary lymphoid organs. Cells Involved in Immune Responses Structure and Functions: Mononuclear cells (phagocytic cells and their killing mechanisms), granulocytic cells (neutrophils, eosinophils and basophils), mast cells and dendritic cell. Lymphoid cells (B-lymphocytes, T-lymphocytes and Natural killer cells).	15hrs
II	Nature of Antigen and Antibody Antigen Vs Immunogen, Haptens Structure and functions of immunoglobulins Istopic, allotypic and idiotypic variations. Generation of Diversity in Immune System Clonal selection theory-concept of antigen specific receptor. Organization and expression of immunoglobulin gens: generation of antibody diversity. Immunization: Active immunization (immunoprophylaxis) Passive immunization	15hrs

	(Immunotherapy) Role of vaccines in the prevention of diseases.	
III	Humoral and Cell-mediated Immune Responses .Kinetics of primary and secondary immune responses. Complement activation and its biological consequences. Antigen processing and presentation. Cytokines and co stimulatory molecules: Role in immune responses. T and B cell interactions. Major Histocompatability Complexes (MHC Products Polymorphism of MHC genes. Role of MHC antigens in immune responses. MHC antigens in transplantation.	15hrs
IV	Measurement of Antigen- Antibody Interaction. Agglutination and precipitation techniques. Radio Immunoassay ELISA and ELISPOT Immune fluorescence assays: Fluorescence activated cell sorter (FACS) technique. Hypersensitivity Immediate (Type I) Cytotoxic (Type II) Immune complex-mediated (Type III) Delayed hypersensitivity (Type IV) Immune Responses in Diseases Immune responses to infectious diseases: viral (HIV), bacterial (tuberculosis) and protozoal (malaria) infections Immunodeficiency disorders: congenital (SCID, Leuckocyte adhesion deficiency, Chronic granulomatous disease) and acquired (AIDS) immunodeficiencies. Autoimmunity	15hrs

Reference Books

Kubey, Immunology, R.A. Goldsby, Thomas J. Kindt, Barbara, A. Osbarne. (Freeman).
Immunology-Ashort Course, -Eli Benjamini, Richard Coico, Geoffrey Sunshine.
Immunology by Tizzard
Fundamentals of immunology by William Paul.
Immunology by Roitt *et al*
Immunology by Abbas

Course Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5	PSO
CO1	1	2	3	3														3
CO2	2	1	2	3														2
CO3	2	2	3	3														3
CO4	3	3	2	3														3

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

M.Sc. BIOCHEMISTRY
SEMESTER – SECOND
BC-203 C(Core Course)
ADVANCED ENZYMOLOGY

Course Outcomes

On the completion of the course, students will be able to:		Level
CO1	Acquire the knowledge of enzymes their properties and classification, Mechanism of action, Michaelis-Menten initial rate equation, methods for the determination of Km and Vmax.	L1
CO2	Learn about enzyme kinetics, effect of enzymes concentration, pHand temperature on kinetics of enzyme reactions, enzyme inhibition and activation, and multi-substrate enzyme kinetics.	L2
CO3	Learn different immobilization techniques	L2
CO4	Industrial and Clinical scope of enzymes.	L2

(TOTAL CREDIT -04,END SEMESTER MARKS-75,CIE-25)

UNIT	Topic	No.of Lectures Hours 60
I	Properties & classification of enzymes. Kinetics of order of reactions, energy of activation, concept of ES complex, active site, derivation of Michaelis-Menten and Briggs-Haldane equations for uni- substrate reactions. Different plots for the determination of Km & Vmax (LB plot, Hanes plot, Eadie Hofstee plot, Eisenthal Cornish Bowden plot). Importance of Kcat/Km. Factors affecting the rates of enzymes catalyzed reactions- pH and temperature. Reversible and irreversible inhibition- competitive, non-competitive, uncompetitive inhibitor.	15hrs
II	Enzyme purification techniques: objectives and strategy, methods of homogenization, method of isolation and purification Mechanism of enzymes action: Chymotrypsin, Triose phosphate isomerase, aldoase, lysozyme – Methods to determine active site. Metalloenzymes.	15hrs
III	Proteins – ligand binding concept & measurement. Allosteric enzymes: Sigmoidal kinetics & their physiological signification. Hill and Scatchard Plots Symmetric and sequential modes of action of allosteric enzymes and their significance. Enzyme regulation: General mechanism of	15hrs

	enzyme regulation. Feed back inhibition and substrate inhibition. Reversible and irreversible covalent modifications of enzymes.	
IV	Immobilized enzymes and their industrial applications. Effect of partition of kinetics and performance with particular emphasis on changes in pH and hydrophobicity. Multienzyme system: Mechanism of action and regulation of pyruvate dehydrogenase and fatty acid synthetase complexes. Immobilized multienzyme system and their applications. Enzymes in medical diagnosis (aspartate aminotransferase, alanine aminotransferase, creatine kinase, lactate dehydrogenase) and enzyme therapy.	15hrs

Reference Books

The Nature of Enzymology by R.L. Foster
Enzymes by Dixon and Webb
Fundamentals of Enzymology by Price and Stevens
Enzyme Catalysis and Regulation by Hammes
Enzyme Reaction Mechanisms by Walsch
The Enzymes vol I and II by Boyer
Enzyme Structure and Mechanism by Alan Fersht
Enzyme Assays: A Practical Approach by Eisenthal and Danson
Enzyme Biotechnology by G. Tripathi
Practical Biochemistry by Plummer.
Practical Biochemistry by Sawhney and R. Singh
Enzymes – Dixon & Webb – Academic press

Course Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	**3**	**3**	**2**	**2**										**3**
CO2	**2**	**2**	**2**	**3**										**3**
CO3	**3**	**2**	**3**	**2**										**2**
CO4	**2**	**3**	**3**	**3**										**3**

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

M.Sc. BIOCHEMISTRY
SEMESTER – SECOND
BC-204 C (Core course)
INTERMEDIARY METABOLISM

Course Outcomes

On the completion of the course, students will be able to:		Level
CO1	Learn Carbohydrate catabolism, and its association with cellular energy production,and carbohydrate anabolism in plants and animal cells.	L1
CO2	Aquire the Knowledge of bioenergetics and energy transformation	L2
CO3	Understand Lipid biosynthesis, Degradation of fatty acids and cholesterol, ketone bodies, acidosis, ketosis.	L2
CO4	Understand about the Biosynthesis of purines and pyrimidine nucleotides, degradation of nucleotides, salvage pathways,biosynthesis and biodegradation of amino acids. Understand detailed mechanism of nitrogen metabolism	L2

(TOTAL CREDIT -04,END SEMESTER MARKS-75,CIE-25)		
UNIT	Topic	No.of Lectures Hours 60
I	Carbohydrates metabolism: Glycolysis, citric acid cycle and pentose phosphate pathway. Gluconeogenesis Glycogenesis & Glycogenolysis Regulation of blood glucose homeostasis by hormones.	15hrs
II	Lipids Metabolism: Biosynthesis-Triacyglycerols, phospholipids, cholesterol, fatty acids, prostaglandins and ketone bodies. Fatty acid oxidation: β- oxidation of saturated and unsaturated fatty acid. Metabolism of circulating lipids: chylomicrons, LDL, HDL, and VLDL, free fatty acids.	15hrs
III	Bioenergetics: Energy transformation, Laws of Thermodynamics, Biological oxidations, Gibb's energy, Free energy changes. Mitochondrial respiratory chain: ETC carriers (iron sulphur proteins, ubiquinone, universal carriers and cytochromes). ETC complexes I,II, III (Q cycle) & IV, the stochiometry of proton extrusion uptake, shuttle system. Oxidative phosphorylation (OP): Coupling of ETC and OP, uncouplers, ATP syntahse, proton motive force, chemiosmotic theory, : P/O and H/P ratios. Mechanism of ATP formation. Respiratory controls and inhibitors of oxidative phosphorylation.	15hrs
IV	Amino Acids Catabolism of tyrosine, phenylalanine, tryptophan, branched chain amino acids. Urea cycle and its regulation.	15hrs

	Nucleic Acids Biosynthesis of Purines and Pyrimidines nucleotides. Degradation of Purines and Pyrimidines nucleotides. Regulation of Purine and Pyrimidine biosynthesis.	

References Books

Harper's Biochemistry – Murray, Granner, Mayes, and Rodwell – Prentice Hall International Inc.
Biochemistry – Lehninger – CBS Publishers.
Biochemistry – Stryer – W. H. Freeman & Co. – New York.
Text Book of Biochemistry – West, Todd, Mason, Bruggen – Amerind Publishing Co. Pvt., Ltd.

Course Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	**3**	**2**	**2**	**3**											**3**
CO2	**2**	**3**	**3**	**1**											**2**
CO3	**3**	**2**	**3**	**3**											**2**
CO4	**2**	**3**	**3**	**2**											**3**

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

M.Sc. BIOCHEMISTRY
SEMESTER –THIRD
BC-301 C (Core Course)
MICROBIAL PHYSIOLOGY & BIOCHEMISTRY

Course Outcomes

On the completion of the course, students will be able to:		Level
CO1	Understand the basics of microbiology like Characterization and classification of microorganisms, cultivation, nutrition, physiology and growth of microbial cells, Learn and understand the basics of mycology, virology and production of mutants and their characterization.	L1
CO2	Understand the basic microbial structure and functions of various physiological groups of prokaryotes and eukaryotes and also learn the theory and practical skills in microscopy handling and staining techniques.Know various Culture media and their applications and understand various physical and chemical means of sterilization and also learn various techniques for isolation of pure cultures	L2
CO3	Comprehend the various methods for identification of unknown microorganismsand study microbial metabolism – Autotrophy and heterotrophy modes of nutrition. Understand the microbial physiology and know the various Physical and Chemical growth requirements of bacteria and get equipped with various methods of bacterial growth measurement	L2
CO4	The students will be able to understand and predict the various metabolic reactions in microbial cell. Understand the architecture of viruses, their classification and the methods used in their study.Discern the replication strategies of representative viruses from the seven Baltimore classes and comprehend the intricate interaction between viruses and host cells	L2

(TOTAL CREDIT -04,END SEMESTER MARKS-75,CIE-25)		
UNIT	Topic	No.of Lectures Hours 60
I	Types of microorganisms, general characteristics of main groups of microorganisms, Nutrition and growth of microbial cells with different growth curve-lag, log, stationary and decline phases. Synchronous growth, pure culture techniques and preservation methods	15hrs
II	Morphology and fine structure of eubacteria and archaebacteria cell wall, cytoplasmic membrane and other organelles. Staining methods: Gram staining, acid-fast, endospore and fungal staining Gram positive and gram negative organisms. Structure & function of peptidoglycan in gram positive and gram negative organisms. Functions of polymeric components in outer membrane and acidic polymers in gram negative organisms. Biosynthesis of bacterial cell wall and use of different inhibitors.	15hrs
III	Food spoilage, fermentation, food-borne infection (Staphylococcal, Clostridial, Salmonellosis, Shigellosis).	15hrs

	Role of microorganisms in domestic and industrial sewage. Methods of sterilization in brief. Metabolism: EDP pathway, Xylose-5-phosphoketolase pathway	
IV	Virus structure, virus proteins, virus classification and methods of assay. Structure of bacteriophage, lytic and lysogenic life cycle Replication of RNA viruses–negative strand (VSV), positive strand (Polio), retrovirus (to include all events in the infectious cycle). Replication of DNA viruses (Adenovirus & SV 40). Virus–host interaction and prevention polio/AIDS, Hepatits	15hrs

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Reference Books

Microbiology, Pelczar, M.J., Chan , E.C.S. and Kreig, N.R., Tata McGraw Hill.
Microbial Genetics, Maloy , S.R., Cronan, J.E.Jr and Freifelder, D. Jones, Bartlett Publishers.
General Microbiology – Stanier, Adelberg, Ingraham – The Macmillan Press – London.
Fundamental Principals of Bacteriology – Salle – TMH Pub. Co. Ltd. – New Delhi.
Microbiology-An Introduction – Tortora, Funke, Case, Benjamin – Cummings Publ. Co.

Course Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9
CO1	3	2	3	3												3
CO2	2	1	3	2												3
CO3	3	2	3	3												2
CO4	2	3	2	2												3

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

M.SC. BIOCHEMISTRY
SEMESTER –THIRD
BC-302 C (Core Course)
NUTRITIONAL BIOCHEMISTRY

Course Outcomes

On the completion of the course, students will be able to:		Level
CO1	The student will learn and understand the basic concepts of nutrition, and nutritional values of foods, and Basal metabolic rate and measurement of energy requirements	L1
CO2	The student will also learn and understand the dietary requirement of carbohydrates, lipids and proteins and their biological significance	L2
CO3	also aid to learn the nutritional requirement and significance of dietary minerals like calcium, phosphorus, magnesium, iron, iodine, zinc and copper and vitamins like vitamin B complex, C and A, D, E & K.	L2
CO4	Understand the condition of malnutrition, its prevention, and Recommended dietary allowances.Understand the condition of malnutrition, its prevention, and Recommended dietary allowances	L2

(TOTAL CREDIT -04,END SEMESTER MARKS-75,CIE-25)		
UNIT	Topic	No.of Lectures Hours 60
I	Basic concepts – Function of nutrients. Measurement of the fuel values of foods. Direct and indirect calorimetry. Basal metabolic rate: factors affecting BMR, measurement and calculation of BMR. Measurement of energy requirements.	15hrs
II	Elements of nutrition – Dietary requirement of carbohydrates, lipids and proteins. Biological value of proteins. Concept of protein quality. Essential amino acids, essential fatty acids and their physiological functions.	15hrs
III	Minerals – Nutritional significance of dietary calcium, phosphorus, magnesium, iron, iodine, zinc and copper. Vitamins – Dietary sources, biochemical functions, requirements and deficiency diseases associated with vitamin B complex, C and A, D, E & K vitamins.	15hrs
IV	Malnutrition – Prevention of malnutrition, improvement of diets. Recommended dietary allowances, nutritive value of common foods. Protein-calorie malnutrition. Requirement of proteins and calories under different physiological states-	15hrs

	infancy, childhood, adolescence, pregnancy, lactation and ageing. Obesity: Definition, Genetic and environmental factors leading to obesity.	

Reference Books

Tietz Fundamentals of Clinical Chemistry, Burtis Ashwood, Saunders
Clinical Chemistry, Kaplan
Clinical Chemistry (Organ Function Test), M.N Chatterjee, Jaypee
Normal and Therapeutic Nutrition,Robinson, Garwick, Macmillan
Nutrition, Paul Insel, Don Ross, Jones and Bartlett
Nutrition and Diet Therapy, Lutz, F. A. Davis
Nutrition And Dietetics, Joshi,Tata McGraw Hill
Practical Clinical Biochemistry, Varley, CBS Publisher's latest Edition

Course Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	**1**	**2**	**3**	**3**													**2**
CO2	**3**	**2**	**3**	**2**													**3**
CO3	**3**	**2**	**3**	**3**													**3**
CO4	**2**	**3**	**2**	**3**													**3**

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

M.Sc. BIOCHEMISTRY
SEMESTER –THIRD
BC-303 C(Core Course)
CLINICAL BIOCHEMISTRY AND BIOSAFETY

Course Outcomes

On the completion of the course, students will be able to:		Level
CO1	The student will be able to clinically assess the laboratory indicators of physiological conditions and diseases.	L 1
CO2	They will know the biochemical and molecular tools needed to accomplish preventive, diagnostic, and therapeutic intervention on hereditary and acquired disorders.	L 2
CO3	The course will The course will also aid in understanding the Biohazard and Biosafety, Biosafety guidelines of Government of India; Definition of GMOs;.	L 2
CO4	Roles of Institutional Biosafety Committee, RCGM, GEAC etc. for GMO applications in food and agriculture; Environmental release of GMOs and Bioethics.	L 2

(TOTAL CREDIT -04,END SEMESTER MARKS-75,CIE-25)		
UNIT	Topic	No.of Lectures Hours 60
I	Disorders of Carbohydrates Metabolism: Diabetes mellitus, glycatedhemoglobins, hypoglycemias, various types of glucose tolerance tests, glycogen storage diseases, galactosemia. Disorders of Lipid Metabolism: Tay-Sach's, Gaucher's and Niemann-Pick diseases, atherosclerosis and diagnosis tests. Disorders of Amino Acid Metabolism: phenylketonuria, alkaptonuria, tyrosinosis, albinism, maple syrup urine disease. Disorders of Nucleic Acid Metabolism: Lesch-Nyhan syndrome, gout orotic aciduria.	15hrs
II	Clinical and biochemical aspects of atherosclerosis, jaundice, diabetes, hepatitis, glomerular nephritis, gall stones, Addison's disease, Conn's syndrome, Cushing's syndrome, hypo & hyperthyroidism, Parkinson's disease and Alzheimer's disease .	15hrs
III	Disorders of Erythrocyte: thalassemias and sickle cell anemia. Diseases and organ function test: liver diseases (jaundice, hepatitis, hemochromatosis, Reye's syndrome) and liver function tests, renal diseases	15hrs

	(glomerulonephritis, nephrotic syndrome, urinary tract infection, urinary tract obstruction, renal failure) and renal function tests.	
IV	Biosafety: Historical Background; Introduction to Biological Safety Cabinets; Primary Containment for Biohazards; Biosafety Levels; Biosafety guidelines - Government of India; Definition of GMOs; Roles of Institutional Biosafety Committee, RCGM, GEAC etc. for GMO applications in food and agriculture; Environmental release of GMOs; Risk Analysis; Risk Assessment; Risk management and communication. Bioethics: Introduction, necessity and limitation	15hrs

Reference Books

Tietz Fundamentals of Clinical Chemistry, Burtis Ashwood, Saunders
Clinical Chemistry, Kaplan
Clinical Chemistry (Organ Function Test), M.N Chatterjee, Jaypee
Normal and Therapeutic Nutrition,Robinson, Garwick, Macmillan
Nutrition, Paul Insel, Don Ross, Jones and Bartlett
Nutrition and Diet Therapy, Lutz, F. A. Davis
Nutrition And Dietetics, Joshi,Tata McGraw Hill
Practical Clinical Biochemistry, Varley, CBS Publisher's latest Edition

Course Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PS
1	2	3	3	3														3
2	3	2	3	2														2
3	3	2	2	3														3
4	2	3	3	3														3

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

M.SC. BIOCHEMISTRY
SEMESTER –THIRD
BC-304 E (optional elective)
GENETIC ENGINEERING

Course Outcomes

On the completion of the course, students will be able to:		Level
CO1	Understand "Gene Regulation mechanism in Prokaryotes, Viruses and Eukaryotes	L 1
CO2	Differentiating between the different mechanisms involved, depending on the organism and the process involved in regulation.	L 2
CO3	Gain knowledge about Recombinant DNA technology by studying about various Vectors and Restriction Enzymes involve.Study of Various Expression Systems and Molecular Markers.	L 2
CO4	Clear & Lucid understanding of the Various Regulatory mechanisms and their Applications Screening of the libraries with the help of "Reporter Genes" and Molecular Markers such as RFLP, RAPD, and AFLP	L 2

(TOTAL CREDIT -04,END SEMESTER MARKS-75,CIE-25)		
UNIT	Topic	No.of Lectures Hours 60
I	**Enzymes used in rDNA Technology: Outline of cloning procedure**, Host controlled restriction and modification: Restriction endonucleases and cognate methylases, Class I, II & III restriction enzymes, Variants of Type II Restriction enzyme, Restriction digestion, Star activity, Restriction mapping, Formation of chimeric DNA, Homopolymer tailing, Synthetic Linkers, Adaptors and DNA ligase; Filling in and Trimming back; Significance of T4 DNA polymerase &Klenow Fragment, Alkaline phosphatase, Reverse transcriptase in cloning.	15hrs
II	**Plasmids**: Plasmid classification on basis of phenotypic traits: Relaxed and stringent control of copy number; Plasmid incompatibility; Plasmid host range, Mobilizable plasmids and Triparental mating; Plasmid as cloning vector (recombinant plasmids): Properties of ideal plasmid cloning vectors, pBR322, pUC& pGEM3Z series, Transcriptional and translational fusion vectors; Fusion proteins; Selectable markers; Reporter genes. .	15hrs
III	**Phage as a cloning vector**: Advantage of using phage lambda vector, Genome map of phage lambda, In vitro packaging,	15hrs

	Insertional and replacement vectors: Cosmid vectors; M13 phage and its role in single stranded DNA production, M13 series of vectors; Phagemids; Yeast as cloning vector: Basic principles of development of yeast vectors, 2μ plasmid, YEP, YRP YCP, YIP; Artificial chromosomes: YACs, BACs and PACs.	
IV	**Screening and selection of recombinants**: Functional (genetic) complementation (Blue-white screening, Red-white screening), Nutritional complementation, Gain of function, Colony hybridization, Plaque hybridization, Southern blotting and hybridization, Dot blot, Zoo blot, Plus-Minus screening, Northern blotting, Immunological screening, Western blotting, South-Western blotting, North-Western blotting, HART, HAT	15hrs

Reference Books

1. Smita Rastogi and Neelam Pathak (2009), Genetic Engineering, Oxford University Press.
2. Gene Cloning and DNA Analysis (2010) 6th ed., Brown, T.A., Wiley-Blackwell publishing (Oxford, Principles of Gene Manipulation and Genomics (2006) 7th ed., Primrose, S.B., and Twyman, R. M., Blackwell publishing (Oxford, UK)
3. Old & Primrose
4. Molecular Biotechnology: Principles and Applications of Recombinant DNA (2010) 4th ed., Glick B.R., Pasternak, J.J. and Patten, C.L., ASM Press (Washington DC),
5. Molecular Cloning: A laboratory manual (2014),4nd ed., Michael R Green and J. SambrookCold spring Harbor laboratory press (3vol.), ISBN: 978-1-936113-42-2

Course Mapping:

PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11
2	3	3	3														
3	2	3	2														
3	2	2	3														
2	3	3	3														

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

M.SC. BIOCHEMISTRY
SEMESTER – SECOND
BC-305E(Optional\Elective)
PHARMACEUTICAL BIOCHEMISTRY

Course Outcomes

On the completion of the course, students will be able to:		Level
CO1	Understand about monoclonal antibodies and its applications along with regulatory requirements	L 1
CO2	Understand about formulation of proteins and peptides, adult-phase drug delivery systems	L 2
CO3	Understand about injectable lipid emulsions, liposomes, polymeric systems for oral protein and peptide delivery.	L 2
CO4	Understand about the pulmonary drug delivery systems for biomolecules; Lipid based pulmonary delivery, Arosols etc. Understand about different polymers used for controlled drug delivery	L 2

(TOTAL CREDIT -04,END SEMESTER MARKS-75,CIE-25)		
UNIT	Topic	No.of Lectures Hours 60
I	Monoclonal antibodies: applications, generation, recombinant antibodies, production methods, Pharmaceutical, regulatory and commercial aspects.	15hrs
II	Formulation of proteins and peptides: making small protein particles, precipitation of proteins, quality control issues, multi-phase drug delivery system; Preparation of collagen, gelatin particles, albumin microparticles	15hrs
III	Proteins and phospholipids: structural properties of phospholipids, injectable lipid emulsions, liposomes, cochleal phospholipids structures; Polymeric systems for oral protein and peptide delivery.	15hrs
IV	Pulmonary drug delivery systems for biomacromolecules; Lipid based pulmonary delivery; Solid colloidal particles; Polycyanoacrylates; Poly (ether-anhydrides); Diketopiperazine derivatives; Poly ethylene glycol conjugates; Factors affecting pulmonary dosing. Aerosols, propellents, containers types, preparation and evaluation, intra nasal route delivery systems: Types, preparation and evaluation.	15hrs

References Books

Groves MJ 'Pharmaceutical Biotechnology', Taylor and Francis Group.

Crommelin DJA, Robert D, Sindelar 'Pharmaceutical Biotechnology'.

Kayser O, Muller R 'Pharmaceutical Biotechnology'.

Banga AK 'Therapeutic peptides and proteins'.

Molecular Cell Biology- by Lodish H., Berk A., Matsudiaira P., Kaiser C.A., Krieger M. and Scott M.P., W. H. Freeman and Company, New York.

Vyas S.P. and Kohli D.V., Pharmaceutical Biochemistry, 1st Edition, CBS Publishers & Distributors, New Delhi

Principles and Techniques of Biochemistry and Molecular Biology by Wilson K. and Walker J. , Cambridge University Press

PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PS
3	3	3															
2	3	2															
2	3	3															
3	3	3															

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

M.SC. BIOCHEMISTRY
SEMESTER – THIRD
BC-401C (Core Course)
APPLIED BIOTECHNOLOGY

On the completion of the course, students will be able to:		Level
CO1	Understand principle and application of PCR, Rapid DNA and RNA sequencing techniques, High throughput Sequencing, and Microarray.	L 1
CO2	Learn about the principle& applications of Blotting and hybridization.	L 2
CO3	Introduced with DNA fingerprinting and Molecular Markers	L 2
CO4	Learn about application of recombinant microorganism, plant biotechnology & animal biotechnology to develop understanding of basics in protein engineering and bionanotechnology	L 2

(TOTAL CREDIT -04,END SEMESTER MARKS-75,CIE-25)		
UNIT	Topic	No.of Lectures Hours 60
I	Principle & applications of PCR; RACE, Degenerate PCR, Realtime PCR, Site Directed Mutagenesis: oligonucleotide directed, PCR based Mutagenesis, Antisense RNA technique, ribozymes, Microarray techniques for DNA	15hrs
II	Rapid DNA and RNA sequencing techniques: Sanger method, Maxam and Gilbert procedure, automated DNA sequencing, pyrosequencing; High throughput Sequencing Human Genome sequencing, and comparative genomics.Molecular Markers: RFLP, RAPD, AFLP, DNase I foot printing. Genome editing.	15hrs
III	Application of recombinant microorganism: Production of recombinant pharmaceuticals, therapeutic proteins, Production of Restriction Enzyme,Production of Antibiotics, Production of Biopolymer,Combating Human Diseases,Biopesticides, Bioremediation	15hrs
IV	Plant Biotechnology:Ti plasmid, Binary and Cointegrate vectors derived from Ti plasmid of Agrobacterium, plant virus vectors, Transgenic plants and their applications. Protein Engineering: Concept of designing of new protein molecule, Application of protein engineering. Basics of nanobiotechnology.	15hrs

Reference Books

Gene Cloning,T. A. Brown,Blakwell
Gene engineering, Joshi, Daya Publication
Gene Isolation and Mapping Protocol,,Jacqueline Boultwood,Humana Press
Molecular Biology and Biotechnology, C A Smith; Edward J Wood, Chapman & Hall
Molecular Biology and Biotechnology, Walker and Repley, Royal Society of Chemistry
Molecular biology and genomics, Cornel Mülhardt, Elsevier Academic Press
Molecular Biotechnology,,Bernard, Glick, ASM Press
Molecular Biotechnology, Primrose,Panima

Course Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1-PSO13	PSO14
CO1	3	3	3	3	3	1	2		3
CO2	3	2	3	2	2	1	3		2
CO3	3	2	3	3	2	2	3		2
CO4	2	3	3	3	3	3	2		3

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

M.Sc. BIOCHEMISTRY
SEMESTER –THIRD
BC-402 C(Core Course)
HUMAN PHYSIOLOGY

Course Outcomes

On the completion of the course, students will be able to:		Level
CO1	Describe the composition of blood and explain the process of erythropoisis and enlist various factors that regulate erythropiosis to explain two pathways that initiate blood clotting different types of blood groups and its importance during blood transfusion.	L 1
CO2	The knowledge of various body fluids such as blood and urine, their detail composition and alterations under various pathological conditions is of paramount importance.	L 2
CO3	To understand excretory system	L 2
CO4	Detailed Physiology of Nerve impulse transmission and muscle contraction is vital to our understanding of these important physiological processes.	L 2

(TOTAL CREDIT -04,END SEMESTER MARKS-75,CIE-25)		
UNIT	Topic	No.of Lectures Hours 60
I	Blood: Composition and functions of plasma, erythrocytes including Hb, leucocytes and thrombocytes, plasma proteins in health ad diseases. Blood coagulation mechanism and regulation, Fibrinolysis. Transfer of gases – oxygen and carbon dioxide. Bohr effect and chloride shift.	15hrs
II	Digestive system: Composition, function and regulation of saliva, gastric, pancreatic, intestinal and bile secretions–digestion and absorption of carbohydrates, lipids and proteins.	15hrs
III	Excretory system: Structure of nephron, formation of urine, glomerular filtration, tubular reabsorption of glucose, water and electrolytes, tubular secretion. Regulation of an electrolytes balance and regulation of kidney function by hormones	15hrs
IV	Nerve: structure of neuron, membrane potential, action potential, voltage gated channels, role of ions during action potential, transmission of action potential, synapse, synaptic transmission. Muscles: Structure of skeletal, smooth & cardiac muscles. Neuromuscular junction and transmission, excitation and contraction coupling	15hrs

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References

Human Physiology, Vol. I & II, - C. C. Chatterjee – Medical Allied Agency – Calcutta.

Concise Medical Physiology – Choudhary – New Central Book Agency – Calcutta.
TextBook of Medical Physiology – Guyton – Prism Books Pvt. Ltd. – Bangalore.

Course Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1-PSO14	PSO15
CO1	3	3	3	3	3	1	2		3
CO2	3	2	3	2	2	1	3		3
CO3	3	2	3	3	2	2	2		2
CO4	2	3	3	3	3	3	2		3

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

M.Sc. BIOCHEMISTRY
SEMESTER- FOURTH
BC-403 E(optional elective)
ENVIRONMENTAL BIOCHEMISTRY

Course Outcomes

On the completion of the course, students will be able to:		Level
CO1	Understand Microbiology of air and aquatic environments, Biological Oxygen Demand and pollution problems.	L 1
CO2	Students will be familiar with environmental pollution, Xenobiotic toxicity/ genotoxicity, Mode of action of pesticides, fungicides and insecticides; Bioaccumulation and bioremediation.	L 2
CO3	Students will become aware of recycling of organic waste, composting and vermi- composting and municipal solid waste treatment and management.	L 2
CO4	Students will get familiarized with Microbial biotransformation/ degradation of organic pollutants, xenobiotics, pesticides, herbicides, heavy metals and radio isotopic materials and biodeterioration.	L 2

(TOTAL CREDIT -04,END SEMESTER MARKS-75,CIE-25)		
UNIT	Topic	No.of Lectures Hours 60
I	Environment: Basic Concept & Issues. Environmental pollution: Types of pollution. Air pollution & its control through biotechnology. Water pollution & its Control: Water as a natural resource, need for water management, measurement of water pollution, source of water pollution.	15hrs
II	Toxic effect: Basis for general classification & nature. Dose-Response relationship. Synergism & Antagonism. Determination of ED-50 & LD-50. Acute & chronic exposures. Factors influencing toxicity,. Xenobiotics metabolism: Phase-I reactions: Oxidation, reduction, hydrolysis & hydration. Phase-II reactions\conjugation: Methylation, glutathione & amino acid conjuctions, detoxifications.	15hrs
III	Pesticide toxicity: Insecticides- Organochlorines, Anti-cholinesterase- Organophosphates and Carbamates. Fungicides, Herbicides. Environmental consequences of pesticide toxicity. Biopesticides. Metal toxicity: Toxicology of Arsenic, Lead and Cadmium in target organs. Metabolism of CCl_4 & Paracetamol & their effect in liver & kidney.	15hrs
IV	Microbiology of degradation of xenobiotics in environment: Ecology considerations,	15hrs

	decay behaviour and degradative plasmid. Hydrocarbons, substituted hydrocarbons, oil pollution surfactants. Global Environment problems: Ozone depletion, Green house effect and acid rain.	

Reference Books

Environmental Biology and Toxicology, P. D. Sharma, Rastogi
Textbook of Toxicology, BalramPani, IK
Casarett&Doull's Essentials of Toxicology, Klaassen, MGH
Toxicology: Principles and Applications, Niesink, CRC
Clinical Toxicology, FACMT, Saunders
Environmental Pollution and Toxicology, Johi, APH

Course Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1-PSO15	PSO16
CO1	3	3	3	1	3	1	2		3
CO2	3	3	3	2	2	2	3		3
CO3	3	2	3	3	2	2	2		3
CO4	2	3	3	3	3	3	2		3

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

M.Sc. BIOCHEMISTRY
SEMESTER- FOURTH
BC-404 E (Optional Elective)
GENOMICS AND PROTEOMICS

Course Outcomes

On the completion of the course, students will be able to:		Level
CO1	Understand Genome sequencing, various types of sequencing technologies and sequencing approaches.	L 1
CO2	Learn Pros and cons of different sequencing technologies. Major genome databases and methods of Genome analysis and their applications	L 2
CO3	Acquire Basics and application of structural genomics, comparative genomics and functional genomics	L 2
CO4	Learn various techniques of proteomics like 2D and MALDI. Methods of protein separation, detection and quantification. Various applications of genomics and proteomics in agriculture, human health and industry	L 2

(TOTAL CREDIT -04,END SEMESTER MARKS-75,CIE-25)		
UNIT	Topic	No.of Lectures Hours 60
I	Introduction Structural organization of genome in Prokaryotes and Eukaryotes; Organelle D NA-mitochondria l, chloroplast; DNA sequencing-principles and translation to large scale projects; Recognition of coding and non-coding sequences and gene annotation; Tools for genome analysis-RFLP, DNA fingerprinting, RAPD, PCR, Linkage and pedigree analysis physical and genetic mapping.	15hrs
II	Genome sequencing projects Microbes, plants and animals; Accessing and retrieving genome project information from web; Comparative genomics.Identification and classification using molecular markers-16s rRNA typing/sequencing, ESTS and SNPS.	15hrs
III	Microarray chips: Types of DNA chips and their production. Gene Therapy for Human Diseases. Protein Crystallization; Theory and methods: API Electrospray and MALDI-TOF. SNP's and GMS (Genome mismatch Signals)	15hrs
IV	L. Proteomics Protein analysis (includes measurement of concentration, amino-acid composition, N terminal sequencing); 2-D electrophoresis of proteins; Microscale solution isoelectricfocusing; Peptide fingerprinting; LC/MS-MS for identification of proteins and	15hrs

	modified proteins; MALDI-TOF; SAGE and Differential display proteomics, Protein-protein interactions, Yeast two hybrid systems. Functional Proteomics: Significance of Proteome research	

Reference Books

Genomics, Proteomics and Bioinformatics, 2nd Edition. Campbell AM & Heyer LJ, Benjamin Cummings 2007; CSH Press, NY. ISBN-10: 8131715590

Principles of Proteomics. R.M Twyman (2004). (BIOS Scientific publishers). ISBN-10: 1859962734

Principles of Gene Manipulation and Genomics- Primrose S & Twyman R, 7th Edition, Blackwell, 2006. ISBN-10: 1405135441

Principles of Genome Analysis and Genomics. Primrose SB & Twyman RM. 2007. Blackwell. ISBN-10: 1405101202

Introduction to Genomics. A.M Lesk, Oxford University press, 2007. ISBN-10: 0199557489

A Primer of Genome Science. Greg Gibson and Spencer V. Muse. 2nd ed. 2004. SINAUER Associates Inc. ISBN-10: 0878932364

Genome III – T.A. Brown Garland Science Publ. June 08, 2006. ISBN-10: 0815341385

Course Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1-PSO16	PSO17
CO1	3	3	3	1	3	2	2		3
CO2	3	1	3	2	2	2	3		2
CO3	3	2	3	3	2	2	2		3
CO4	2	3	1	3	3	3	2		2

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

M.Sc. BIOCHEMISTRY
SEMESTER- FOURTH
BC-405 E (Optional Elective)
GENE EXPRESSION AND REGULATION

Course Outcomes

On the completion of the course, students will be able to:		Level
CO1	Transcription in Eukaryotes, Transcription factors, Nucleosome modifiers, Mediator complexes, Chromatin remodellers, Elongation factors in transcription; Cleavage and polyadenylation.	L 1
CO2	Learn and understand Post - transcriptional / Co-transcriptional processing of RNA, End modifications, RNA splicing, RNAediting, Alternative splicing.	L 2
CO3	Understand the fundamentals of translation in prokaryotes and eukaryotes, properties of Genetic code, Ribosome binding site; Formation of initiation complex; Transpeptidation and Translocation; Ribosome cycle	L 2
CO4	Understand Post - translational processing, splicing, Chemical modification, Proteolytic cleavage, Zymogen activation to understand regulation of gene expression; Concept of operon, Significance of repressor, Attenuation; Inhibitors of transcription and translation.	L 3

(TOTAL CREDIT -04,END SEMESTER MARKS-75,CIE-25)		
UNIT	Topic	No.of Lectures Hours 60
I	Transcription in eukaryotes: Synthesis of pre-mRNA: Outline of process - Initiation, elongation and termination, RNA Pol II, promoter, Enhancer elements, Subunit structure of RNA Pol II, Roles of RNA polymerase II, Transcription factors, Nucleosome modifiers, Mediator complexes, Chromatin remodelers, Elongation factors in transcription; Synthesis & processing of pre-rRNA and pre-tRNA: Outline of process, RNA Pol I and III, promoters sequences..	15hrs
II	**Co-transcriptional processing**: Addition of 5` cap and 3' Poly A tail in mRNA; **Post transcriptional processing**: RNA splicing – Type 1 and Type 2 Intron splicing, Spliceosome mediated splicing and maturation of precursors of rRNA, mRNA, tRNA): Role of different ribonucleases in splicing, Covalent modifications, RNA editing, Alternative splicing, Histone mRNA processing	15hrs
III	Translation in prokaryotes and eukaryotes: Outline of the process - Initiation, elongation and termination; Adapter role of tRNA, Genetic code, Evidences for a triplet	15hrs

	codon; Properties of Genetic code; Codon family and Codon pairs; Nonsense and Sense codons; Degeneracy: Significance of Isoacceptor tRNAs and Wobble hypothesis; Codon bias; Amino acyl tRNA synthetase: Classification, Specificity, Reaction catalyzed; A, P and E sites of ribosome; Start and stop codons, Ribosome binding site; Formation of initiation complex; Transpeptidation and Translocation; Ribosome cycle; Roles of Initiation factors, Elongation factors, Release factors, Ribosome recycling, Aminoacyl tRNA synthetases, catalytic role of GTP, Peptidyl transferase site and Factor binding site of ribosomes in translation. Proofreading activity of ribosomes and Fidelity of Translation	
IV	Regulation of prokaryotic gene expression; Concept of operon: Lac, Trp and Ara operons, Significance of repressor, Attenuation; Inhibitors of transcription and translation.	15hrs

Reference Books

Lehninger,Albert,Cox,MichaelM.Nelson,DavidL.(2017) Lehninger principles of biochemistry/NewYork:W.H.Freeman.

Lewin "Genes"

Freifelder, DM "Molecular Biology"
Brown, TA "Genomes"
Watson, JD "Molecular Biology of the cell"
Twyman, R.M.Advanced Molecular Biology"
Brown, TA"Gene cloning: An introduction"
Old & Primrose "Principles of Gene Manipulation"
Primrose, SB "Molecular Biotechnology"
Jose B. Cibelli, Robert P. Lanza, Keith Campbell, Michasel D. West "Principles of Cloning"

Course Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1-PSO17	PSO18
CO1	**3**	**3**	**3**	**1**	**3**	**2**	**2**		**3**
CO2	**3**	**1**	**3**	**2**	**2**	**2**	**3**		**2**
CO3	**3**	**2**	**3**	**3**	**2**	**2**	**2**		**3**
CO4	**2**	**3**	**1**	**3**	**3**	**3**	**2**		**2**

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

M.Sc. BIOCHEMISTRY
SEMESTER- FOURTH
BC-406 E (optional elective)
MEDICAL BIOCHEMISTRY

Course Outcomes

On the completion of the course, students will be able to:		Level
CO1	Discuss the fundamental biochemistry knowledge related to health and explain the clinical significance of the laboratory tests.	L 1
CO2	Diagnosis of clinical disorders by estimating biomarkers determine various substances including substrates, enzymes, hormones, etc and their use in diagnosis and monitoring of disease are applied.	L 2
CO3	Evaluate the abnormalities which commonly occur in the clinical field.	L 3
CO4	Review the information from each category of tests and develop a protocol for disease diagnosis to create awareness of different lifestyle diseases increasingly found in present day	L 3

(TOTAL CREDIT -04,END SEMESTER MARKS-75,CIE-25)		
UNIT	Topic	No.of Lectures Hours 60
I	**Disorders of Carbohydrates Metabolism** Diabetes mellitus, Glycated hemoglobins, Hypoglycemias. Various types of glucose tolerance tests. **Disorders of Thyroid** Hyperthyroidism, Hypothyroidism. Thyroid function Tests: T3, T4, TSH, TRH	15hrs
II	**Disorders of Lipids** Hypoliproteinemia, Hyperlipoproteinemia, Atherosclerosis Diagnostic tests for apolipoproteins, HDL – cholesterol, LDL – cholesterol and triglycerides. **Diagnostic Tests for Proteins** Total protein, albumin, globulin and fibrinogen	15hrs
III	**Liver Function Tests** Van den Bergh test for bilirubin, urine and fecal urobilinogen Determination of galactose, epinephrine test Detoxification and excretion tests Prothrombin Time Determination of blood ammonia **KidneyFunction Tests** Urea clearance test, Creatinine clearance test Renal plasma flow Concentration and dilution test	15hrs
IV	**Biochemical Aspects of Hematology**	15hrs

	Complete blood count (CBC)- red blood cell, white blood cell, platelet counts, percent hemoglobin Bleeding time, clotting time Serum Aspartate aminotransferase, alanine aminotransferase, creatine kinase, gamma glutamyl transpeptidase, alkaline phosphatase	

Reference Books

Tietz Fundamentals of Clinical Chemistry, Burtis Ashwood, Saunders
Clinical Chemistry (Organ Function Test), M.N Chatterjee, Jaypee
Biochemistry, A.C. Deb,Central

Course Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1-PSO18	PSO19
CO1	3	3	3	1	3	2	2		3
CO2	3	1	3	2	2	2	3		2
CO3	3	2	3	3	2	2	2		3
CO4	2	3	1	3	3	3	2		2

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

M.Sc. BIOCHEMISTRY
SEMESTER- SECOND
M.Sc. BIOCHEMISTRY
SEMESTER –SECOND
Minor
ESSENTIALS OF MOLECULAR BIOLOGY

Course Outcomes

On the completion of the course, students will be able to:		Level
CO1	Learn about nucleic acid as genetic information carriers, Possible modes of replication and roles of helicase, primase, gyrase, topoisomerase, DNA Polymerase, DNA ligase and Regulation of replication	L 1
CO2	Understand the detailed mechanism and regulation of Eukaryotic DNA replication, along with Mitochondrial and Chloroplastic DNA Replication	L 2
CO3	Learn about mechanism and regulation of transcription in prokaryotes along with Reverse transcription	L 2
CO4	Understanding about the classes of DNA sequences, Genome-wide and Tandem repeats, Retroelements, Transposable elements, Centromeres, Telomeres, Satellite DNA, Mini satellites, Microsatellites; Applications of satellite DNA and Split genes	L 2

(TOTAL CREDIT -04,END SEMESTER MARKS-75,CIE-25)		
UNIT	Topic	No.of Lectures Hours 60
I	Organization of Genetic materials in prokaryotes and Eukaryotes: Genetic material, Genome type, Size, Genome Organization - Structural Maintenance of Chromosomes (SMC) Protein, Eukaryotic Nucleosomes, Histones, Chromatin, Concept of Gene, mono-cistronic and poly-cistronic genes, Gene Structure with various functional units - replicon, muton, recon, C-value and C-value paradox; Unique sequences and Cot value, reassociation kinetics, Split genes: Exons and Introns.	15hrs
II	**Replication:** Modes of replication: Details of Meselson and Stahl experiment; Prokaryotic DNA replication:Origin and Initiation, elongation and termination; Roles, properties and mechanism of action of DnaA, Helicase, Primase, DNA gyrase,Topoisomerases,DNA Polymerases, DNA ligase, Leading and lagging strands; Okazaki fragments; RNA primers;Regulation of replication; Fidelity of replication; Viral replication, σ or Rolling circle replication in ϕX174 **DNA** damage and DNA repair**:** Types of DNA damages,Types ofDNARepair systems, Photoreactivation.	15hrs

III	Eukaryotic DNA replication: Initiation, elongation and termination; Multiple replicons/initiation sites; Autonomously replicating sequence; Mechanism and significance of Origin recognition complex, Mini-chromosome maintenance proteins, DNA dependent DNA polymerases α, δ, ε, Nucleases, DNA ligase and Telomeres in eukaryotic nuclear DNA replication; Regulation of eukaryotic DNA replication; Mitochondrial and Chloroplast DNA replication.	15hrs
IV	Transcription in prokaryotes: Initiation, elongation and termination; Prokaryotic promoter; weak and strong promoters, DNA dependent RNA polymerase: Physical properties, Templet strand, non-template strand, coding strand, Subunits, σ factor, its types and function; Recognition of promoter; Transcription bubble, Direction of Transcription; Abortive initiations; Promoter clearance; Elongation factor Gre and its role, Rho dependent and Rho independent termination of transcription; Sigma cycle; RNA - dependent DNA polymerase.	15hrs

Reference Books

Genes XI , by Benjamin Lewin

Biochemistry – J. David Rawn – Neil Patterson publication, NC.

Cell and Molecular Biology: Concepts and Experiments, by Gerald Karp

Transcriptional Regulation in Eukaryotes, by Carey and Smale

Translational control of gene Expression, by Sonenberg *et al*

Chromatin and Gene Regulation, by Turner

An Introduction to Genetic Analysis, by Griffiths *et al*

Course Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1-PSO19	PSO20
CO1	**3**	**3**	**3**	**1**	**3**	**2**	**2**		**3**
CO2	**3**	**1**	**3**	**2**	**2**	**2**	**3**		**2**
CO3	**3**	**2**	**3**	**3**	**2**	**2**	**2**		**3**
CO4	**2**	**3**	**1**	**3**	**3**	**3**	**2**		**2**

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

National Regional International

The Syllabus of M.Sc Biochemistry is designed to expose the students to recent exciting developments in the area of biochemistry internationally

B.P.E.S SEMESTER –I

PAPER –I ENGLISH LANGUAGE (Optional)

Max. Marks: 50
External Marks: 40
Internal Marks: 10
Time: 3 hours

Section-A

(1) Story/ Prose

One essay type question on Summary/Character/Incident (one out of two with internal choice.)

(2) Story/ Prose: Short questions to test student's grasp

(3) Poetry: Summary (one out of two with internal choice)

Paraphrase/Explanation of a Stanza (one out of two with internal choice)

Section-B

Grammar

THE GRAMMAR RELATED TO THE TEXT TO TEST THE UNDERSTANDING OF THE LANGUAGE,SYNTAX, TENSES ETC.

Section-C

Language-in-Use

1. Letter-Writing (Personal and Applications)

2. Essay: five or six topics to be given, out of which three topics should be related to Sports/physical education.

Reference :

4. Modern Principles of physical education by J.R. Sharman
5. Principles of physical education by J.F. Williams.
6. Physical Education interpretations and objectives by Jay B. Nash.

(History or physical education)

1. History of physical education by Eraj. Ahmed Khan.
2. Brief History of physical education by emmel A. Rice.
3. Physical education in India. National Association of Physical education and recreation India.
4. History of physical education by F.E. Leonard and George B. Affleck.

B.P.E.S SEMESTER –I

PAPER – III FOUNDATIONS OF PHYSICAL EDUCATION

Max. Marks: 60
External Marks: 40
Internal Marks: 20
Time: 3 hours

UNIT – I

1. Introduction Concept and definition of education and physical education. Terminologies related to physical education. Need and importance of physical education. Place of physical education in Tagore's scheme of education. Modern concept and scope of physical education. Aim and objectives of physical education.

UNIT-II

2. Biological Foundation Biological basis office and biological weakness of human in relation to physical activities. Growth and development – Principles, Stages and Affecting factors. Age and Sex difference and physical activities. Concepts and components of physical fitness wellness and active life style. Somatotypes

UNIT-III

3. Philosophical Foundation Meaning of philosophy Different schools of philosophy applied to physical education Psychological Foundation Concept of learning and motor learning Laws of learning Learning curve Psychological factors influencing motor learning

UNIT-IV

4. Sociological Foundation Concept of social institutions and socialization Sports as social institution and their influence on society. Games and sports as Man's cultural heritage Role of games and sports in National and international integration

REFERENCES : • Williams J.F. - Principles of Physical Education

(a) PROPOSED SYLLABUS FOR B.A. ENGLISH CCS University Meerut.
(d) Texts Prescribed for Grammar Oxford Practice Grammar by John Eastwood.

B.P.E.S SEMESTER –I

PAPER –II PRINCIPALS AND HISTORY OF PHYSICAL EDUCATION

Max. Marks: 60
External Marks: 40
Internal Marks: 20
Time: 3 hours

UNIT- I

1.1 Meaning concept and scope of physical education.
1.2 Importance of physical education as a profession.

UNIT- II

2 Physiological Principles :
2.1 Principles governing growth and development significance of age & sex.
2.2 Principles of use; disuse and overuse.
2.3 Human energies and how they are spent
2.4 Fatigue, stress and its effect on physical; mental health; relaxation; flexibility, rhythms and strength.

UNIT- III

3. Psychological principles :
3.1 Personality, psycho-social needs for the normal development, success, recognition, security adventurers experience.
3.2 Transfer of training, laws of learning, conditioned reflex, effect of emotions on health, competition; co-operation, age and sex characteristics.

UNIT- IV

4. History of physical education:
4.1 Physical education in ancient civilizations
4.2 Ancient India – Vedic and Epic period.
4.3 Ancient Greece –Sparta and Athens.
5. Physical Education in modern India :
5.1 Physical education during British period (from 1825 to 1930 A.D.)
5.2 Recent Developments in physical education & sports after independence.
5.3 Asian Games
5.4 Youth movement including youth hostel, Cadet Corps etc.

Reference :
(Principles of Physical Education)
1. Foundation of physical education by Charles A. Bucher.
2. Introduction of Education by J. R. Sharman.
3. Physical education by Oberteuffer, Delbert.

10

- Bucher C.A. – Foundations of Physical Education
- Barrow H.M. – Man and Movement
- Singer Robert – Foundation of Physical Education
- Freeman – Physical Education in Changing Society
- Howell – Foundation of Physical Education, Friend publication, New Delhi

B.P.E.S SEMESTER –I

PAPER –IV

STUDY OF OLYMPICS

Max. Marks: 60
External Marks: 40
Internal Marks: 20
Time: 3 hours

UNIT-I THE OLYMPIC MOVEMENT

1.1 The ancient Olympic games
1.2 The Olympic movement
1.3 Aims and symbols of the Olympic movement
1.4 The International Olympic Committee (IOC)

UNIT-II STRUCTURE OF THE OLYMPIC MOVEMENT

2.1 The National Olympic Committee(NOC)
2.2 The International Sports Federations(IFs)
2.3 The National Sports Federations(NFs)
2.4 Volunteerism

UNIT-III THE OLYMPIC GAMES

3.1 Organization
3.2 The international bid process for selecting sites for the games
3.3 Participation in Olympic games
3.4 Women and sports

UNIT-IV IOC PROGRAMMES

4.1 Olympic academy
4.2 Olympic solidarity
4.3 Olympic museum
4.4 Paralympic games
5.1 Sports for all
5.2 Culture, olympism, winning, participation and universality of the games

4.3 Drug abuse and doping
4.4 Arbitration and dispute resolution

References:

- Carto, J.E.L. And Calif, S.D. [ed], Medicine & Sport Science: Physical Structure of Olympic Athletes, London: Karger, 1984
- Cliw, Gifford, Summer Olympic" 2004
- Daw, Anderson, The story of the Olympics, 2008.
- Maranirs David, Rome 1960: The Olympics that changed the world, 2008.
- Osborne, Manpope, Ancient Greece and the Olympic, 2004.
- Oxlade, chris., Olympic, 1999.
- Perrottet, tony, The Naked Olympics: the true story of the Ancient Games, 2004.
- Singh, M.K., Indian Women and Sports, Rawat Publication, 1991.
- Toropove, Brandon., The Olympic for Beginners, 2008.
- Wallechineley, Davi, The Complete Book of the Olympic, 1992.

B.P.E.S SEMESTER –II
PAPER – I
ANATOMY & PHYSIOLOGY

Max. Marks: 60
External Marks: 40
Internal Marks: 20
Time: 3 hours

Unit-I

Meaning of anatomy, cell, structure, properties of living matter. The role of anatomy in physical education & sports, anatomy of bones cartilage's, Names and location and functions of bones, kinds of bones, joints end their types, tissues, organs and system of body.

Unit-II

Anatomy of muscular system, structure of muscles and their kinds. Properties of muscles. Muscle work and, fatigue, anatomy of respiratory organs, tissue and palmary respiration, anatomy of heart, function of heart, heart beat, stroke volume, cardiac output.

Unit-III

Anatomy of digestive organs (alimentary canal), structure and functions of excretory system, meaning of endocrine glands and structure of the following glands - pituitary glands, ingroid parathyroid, adunal glands.

Unit-IV

Effect of exercise and training on cardiovascular system.
- Effect of exercise and training on respiratory system.
- Effect of exercise and training on muscular system
- Physiological concept of physical fitness, warming up, conditioning and fatigue.

Ref.:-

1. Introduction to anatomy & physiology - Dr. Shemsher Singh.

12

□□Raj Yoga- Swami Vivekanand
□□Bhakti Yoga – Swami Vivekanand.

B.P.E.S SEMESTER –II
PAPER – III
KINESIOLOGY

Max. Marks: 60
External Marks: 40
Internal Marks: 20
Time: 3 hours

UNIT- I

1.1 Introduction to Kinesiology
1.1.1 Definition
1.1.2 Objectives of Kinesiology
1.1.3 Role of Kinesiology in Physical education
1.2 Fundamental concepts of following terms with their application to the human body.
1.2.1 Axes and planes
1.2.2 Center of Gravity
1.2.3 Line of Gravity

UNIT- II

2.1 Anatomical and Physiological fundamentals
2.1.1 Classification of joints and muscles
2.1.2 Terminology of fundamental movements
2.1.3 Types of Muscle contractions
2.1.4 Angle of Pull
2.2 Kinesiology of Joints
2.2.1 Two joints muscles
2.2.2 Roles in which muscles may act.

UNIT- III

3.1 Upper Extremity
3.1.1. Major characteristics of joints
3.1.2 Location and action of major muscles acting at the following joints
3.1.2.1 Shoulder
3.1.2.2 Elbow
3.1.2.3 Wrist
3.2 Lower Extremity
3.2.1 Major characteristics of joints
3.2.2 Location and action of major muscles acting at the

(13)

2. Lawrence, Thomas Gordan; Your health and Safety, Har Schiver. Alics; Powers, Courts, Braco & World, inc. Douglas F; and Vorhana Levis J. New York. 1969.
3. Bauer. WAV. (Editor). TODAYS' Health Guide, American Medical Association, Revised Edition 1968.

B.P.E.S SEMESTER –II
PAPER – II
YOGA

Max. Marks: 60
External Marks: 40
Internal Marks: 20
Time: 3 hours

UNIT – I

1.1 Yoga-Meaning concept, Mis-conceptions about Yoga-Relationship with physical education.
1.2 Historical Background of yoga-yogic practices.

UNIT-II

2.1 Yoga as a discipline of life mode of living, cults of yoga (only central ideas)
2.1.1 Raj Yoga
2.1.2 Bhakti Yoga
2.1.3 Karm Yoga
2.1.4 Gyna Yoga
2.2 Hatha yoga philosophy.

UNIT-III

3.1 Astanga Yoga with special reference to –
3.1.1 Yamas
3.1.2 Niyams
3.1.3 Asanas
3.1.4 Pranayams ; Types of Asanas and Pranayams.
3.2 Shat Karma-Personal hygiene of Yoga – Six purifactory methods of yoga-Neti, Dhauti, Vasti, Nauli, Gajkarni, Kunja.

UNIT-IV

4.1 Bandhas, Mudras and Chakras of Yoga
4.2 Recent advances in Yoga Education; Yoga as a Science
5.1 The therapeutic values of Yogic practices
5.2 Corrective values of Yogic Practices

REFERENCES :

□□Asanas & Pranayams – Swami Kuvalayananda.
□□Yoga Personal Hygiene- Shir Yogendra
□□Yogic Exercises by the Fit and the Ailing – S. Muzumdar
□□Yogic Asanas for Health and Vigour – Dr. Role
□□Hath Yoga : Goswami, S.S.

(14)

following joints :
3.2.2.1 Hip
3.2.2.2 Knee
3.2.2.3 Ankle and Foot

UNIT- IV

4. Application of Mechanical Concepts
4.1 Motion
4.1.1 Definition
4.1.2 Newton's Laws of Motion
4.1.3 Application to sports activities
4.2 Force
4.2.1 Definition
4.2.2 Magnitude of force
4.2.3 Direction of application of force
4.2.4 Application to sports activities
4.3 Equilibrium
4.3.1 Definition
4.3.2 Major factors affecting equilibrium
4.3.3 Role of equilibrium in sports
4.4 Lever
4.4.1 Definition Lever
4.4.2 Types of Lever
4.4.3 Application of Human body

REFERENCES :

Broer, M.R. Efficiency of Human movement (Philadelphia : W.B. Saunders Co., 1966)
Bunn, John W. Scientific Principles of Coaching (Engle Wood Cliffs: N Prentice Hall Inc., 1966)
Duvall, E.N. Kinesiology (Engle wood cliffs : N.J. Prentice Hall Incl. 1956)
Rasch and Burke, Kinesiology and AppliedAnatomy (Philadelphia : Lea and Fibger 1967)
Scoot M.G. Analysis of Human Motion, New York.
Wells, K.P. Kinesiology (Philadelphia : W.B. Saunders Co. 1966)
Cooper, John M. and Glassgow, R.B. Kinesiology (St. Louis C. MeSby Co., 1963)
Hoffman S.J. Introduction to Kinesiology (Human Kinesiology publication in 2005)
Uppal A.K. Lawrence Mamta MP Kinesiology (Friends publication India 2004).

B.P.E.S SEMESTER –II
PAPER- IV
Sports Nutrition

Max. Marks: 60
External Marks: 40

(15)

Internal Marks: 20
Time: 3 hours

Unit-I

- Concept of Nutrition, Sport Nutrition and Health
- Types and Sources of Nutrients
- Main function of Macro and Micro nutrients in health and sports
- Balanced diet

Unit-II

- Energy for sports performance and the role of carbohydrate, protein, fat and their sources.
- A factor affecting the energy needs in different categories of sports events.
- Sports supplements and their effect on performance.
- Nutritional requirements and allowances for sports person of different categories Competition nutrition and its management glycaemic index and sports nutrition

Unit-III

- Management of Hypertension atherosclerosis and dieters mellitus in sportsperson.
- Management of the female sportsperson
-Menarche and Menstruation
-Amenorrhea
-Anemia and Iron Supplementation
-Bone Health and Calcium Supplementation
- Eating Disorders

Unit-IV

Weight Control

- Basic principles of weight control
- Calorie concept of weight control
- Fat reduction and role of fat loss supplements
- Role of diet in weight control.

Reference Books:

1. Bean, A. (2001).
2. Sports Nutrition. Biddles Ltd, Guildford and Kings Lynn.
3. Zimmermann, M. (2007). Handbook of Nutrition, Saurab Printers Pvt Ltd.
4. Antoonio, J and Stout, J.R. (2001). Sports supplements. Lippincott Williams & Wilkins.

16

B.P.E.S SEMESTER – III
PAPER – I
HEALTH EDUCATION

Unit-I

Health Education

- Concept and meaning of Health.
- Concept, meaning, definition, and scope of health education.
- Principles and practice of health education.
- Planning and evaluation in health education programmes.
- Organisation and administrative set up of health services in India

Unit-II

Hygiene

- Hygiene: The concept of hygiene and personal hygiene.
- Care of skin, mouth, teeth, nose, eyes, hands, feet, nails, hair clothing, vital genital organs etc.
- Importance of rest, sleep, diet and exercise.

Community Health:

- Community Health: Brief account of housing water supply, sewerage and refuse disposal.

School Health Programmes:

- School Health Service: History, School Health Problems. Health appraisal, healthy school envir nutritional services, mental health, school health programmes/services, school health records, Safety measures in the playfields – first aid and emergency care

Unit-III

Diseases

- Disease: Meaning of a disease, diseases cycle, epidemiological trials, modes of disease transmission and immunity.
- Health Problem in India: Problems related to communicable diseases: (HIV- AIDs, Hepatitis, Malaria, Ra and Tetanus) nutrition, environmental sanitation, medical care and population.
- Eating Disorders - Anorexia Nervosa, Bulimia Nervosa and Binge Eating Disorders

Unit-IV

Sex Education

- Concept and meaning of sex education
- Need of sex education to the professional students.

Family Planning

- Meaning and concept of family planning.
- Methods to control child birth
- National family welfare programme

other and child health care

ference Books:

ingh Ajmer and et al, "Essential of physical Education" (2007) 3rd edition, Kalyani
ublisher B-1/292, Rajinder Nagar Ludhiana Punjab.
Pandey, P.K. and Gongopadhay, S. R. "Health Education for School Children", Friends
Publication, 6, Mukerjee Tower, Dr. Mukerjee Nagar-Delhi.
Park, J.E. and Park , K. "Text Book of Preventive and Social Medicine", (1985) Bnasidar 91 Bhanot ,
blisher,Jabalpur-1985

B.P.E.S SEMESTER – III
PAPER – II
SPORTS PSYCHOLOGY

ax. Marks: 60
ternal Marks: 40
ernal Marks: 20
me: 3 hours

UNIT – I

Introduction :
eaning definition and nature of Psychology and Educational
ychology.
ychology as a Science.
portance of Psychology in Physical Education.

UNIT –II

Growth and Development :
.1 Meaning of growth and development.
.2. Physical, Mental & Social development during following
ges :-
.2.1 Early childhood
.2.2 Middle childhood
.2.3 Late childhood
.2.4 Adolescences
Individual Differences:
.1 Meaning of the term individual difference
.2 Heredity and Environment as causes of Individual
fferences
.3 Interaction of Heredity and Environment

UNIT – III

Learning
Meaning definition and nature of learning
Principles/Laws of Learning
Factors affecting Learning
Meaning and Conditions of Transfer to Training

UNIT – IV

Motivation and Emotion :
.1 Meaning of Motivation

18

4.1.2 Concept of need, drive, motive, incentive and achievement
4.1.3 Types of Motivation
4.1.4 Role of Motivation in teaching physical activities
4.2 Emotion :
4.2.1 Meaning and nature of Emotion
4.2.2 Types of Emotion
21 22
4.3 Personality :
4.3.1 Meaning and nature of Personality
4.3.2 Dimensions of Personality
5. Introduction to Sports Psychology
5.1 Meaning and area/scope of sports psychology
5.2 Importance of sports psychology for physical educationists Coaches and players

REFERENCES :

Gates, A.I. at al. Educational Psychology (Macmillan Co. N.Y. 1957)
Lindgram, H.E. Advanced Educational Psychology in the classroom.
Kuppuswami, B. Advanced Educational Psychology (Sterling Publishers Pri. Ltd., 1947)
Oxendine, J.B. Psychology and Motor Learning (Engle wood chffs : New Jersey, 1968)
Dr. M.L. Kamlesh, "Psychology of Physical Education of Sports" metropolitan, New Delhi 1983.
Jack H. Liewellyn, Judy A. Bluckeye,. Psychology of Coaching Theory and application Surjeet Publication, Delhi 1982.

B.P.E.S SEMESTER – III
PAPER – III
PHYSIOLOGY OF EXERCISE

Max. Marks: 60
External Marks: 40
Internal Marks: 20
Time: 3 hours

UNIT – I

- Definition of physiology and its importance in the field of physical education and sports.
- Structure, Composition, Properties and functions of skeletal muscles.
- Nerve control of muscular activity:
- Neuromuscular junction
- Transmission of nerve impulse across it.
- Fuel for muscular activity
- Role of oxygen- physical training, oxygen debt, second wind, vital capacity.

1. Energy –
Meaning of energy
Production and use of energy.
Types of Energy
Aerobic and anaerobic of muscular energy.

UNIT-II

(19)

2. Muscles :-
2.1 Types of muscles
2.2 Characteristics of skeletal muscles, innervation and blood supply.
2.3 Microscopic structure of muscles fiber, sensory organ of muscle.
2.4 Biochemical changes in muscles during exercise, second wind.
2.5 Muscles fatigue and recovery process, debt.

UNIT-III

3. Circulatory System :
3.1 Functioning of heart during exercise.
3.1.1 Stoke volume
3.1.2 Cardiac output
3.1.3 Pulse rate
3.2 Effect of training on functioning of heart.
3.3 Blood-constituents, Role during exercise-Blood lacta CO2 in blood, O2 carriage in body Oxyhemoglobin, Blood pressure changes during exercise.

UNIT – IV

4. Respiratory System :
4.1 General functioning of the system-Various measures & capacities like Vital capacity, tidal air, residual air, inspiration and expired air pressure.
4.2 Transportation of gases.
4.2.1 At lung level
4.2.2 At Cellular level
4.3 Changes during exercise in respiratory system.
4.4 Effect of long term training on respiratory capacities.

Reference :

- Physiology of Exercises – by Maccurdy and Mekenzh.
- Physiology of Exercise – by Karpovich.
- Sports physiology – by Fox
- Exercise physiology – by Morehanse & Miller.
- Physiological Basis of Physical Education and Athletics by Mathews and Fox.
- Exercise Physiology – by David H. Clarke.

B.P.E.S SEMESTER – III
PAPER – IV
MANAGEMENT IN PHYSICAL EDUCATION

Max. Marks: 60
External Marks: 40
Internal Marks: 20
Time: 3 hours

UNIT – I

1 Management and Organizational Structure :

20

Meaning and Definition of the Terms – Administration and Management. Elements/Phases of Management (Planning, Organizing, staffing; Directing and Coordination; Supervision and Control/ Evaluation, Re-adjustments and Improvement/ Follow-up) Importance/Significance of the Subject Management in Physical Education and Sports. Principles of Management.

UNIT- II

2. Facilities and Equipments :

The Need for Out-door Facilities: Principles for their Location and the Recommended Area.
Selection/Types of Surfaces, Drainage System, Fencing (Protection), Seating Arrangements and Parking.
Guidelines/Principles for the Lay-out of out door Facilities. Care and Maintenance of Out-door Facilities
Gymnasium: The need, Location, Dimensions, Sample Floor Plans.
Swimming Pool: The Need, Construction, Maintenance and Supervision.
The need for Equipments and their Types. Procedure for the Purchase of Equipments.
Principles to be followed for the Purchase. Store Room Management: Need, Location, Fixtures, Handing of equipments, Issuing Procedure and Periodical Stock- Checking.
Stocking of Leather Equipments, Rubber Equipments, Wooden Equipments, Cloth Uniform Shuttle Cocks, Mattresses, Swimming and Track Equipments. Repairs and Disposal of Damaged Equipments.

UNIT – III

3. Staff and Leadership

Head of the Institute/Department and his Role in Imbibing the Spirit of Discipline among his Staff and Students.
Qualifications of Physical Educators for Different Level Assignments.
Qualities of a Good Physical Education Teacher.

UNIT - IV

4. Class Management & Office Management

Teacher's Preparation before Class (Lesson Plan, Markings of the Courts, Necessary Equipments Suitable Uniform).
Students Preparation Handling and Controlling the Class.
Attendance System.
Grading the Student.
Preparing Reports.
The Need for Office, It's Location and Set up.
Office Function and Practice.

REFERENCES :

Joseph P.M. Organization of physical Education. The old students Association, IIPE, Candiwali, Bombay 1963.
Voltmar, B.P. et. al. The Organization and Administration of Physical Education, Prentice Hall Inc. New Jersey, 1979.
Bucher, C.H. Administration of Physical Education and Athletic programmes, The C.V. Mosby Company, London,1983.
Zigler, E.M. and Dewte, G.W. Management Competency Development in Sports and Physical Education, Lea and Febiger, Philadelphia, 1983.
Maheshwari, B. Management by Objectives Tabe Mc. Graw Hill publishing company Ltd., New Delhi, 1982. Allen, L.A. Management and Organization Mc-Graw Hill Book Company Inc. London 1958.
Newman, W.D. Administrative Action, Prentice Hall I.C.,New Jersey 1963.
Hugeam W.L.et.al. Administrative of Physical Education.The Ronald Press, Company, New York,1962.
Venderzwag, H.J. Sports Management in Schools and Colleges, McMillian Publishing company, New York,1935.
Larry Horine, Administration of Physical Education and Sports, Wm. C. Brown Publishers, 1991 (IInd Edition)

21

B.P.E.S SEMESTER –IV

PAPER – I

FUNDAMENTAL OF COMPUTER AND ITS USE IN PHYSICAL EDUCATION

Max. Marks: 60
External Marks: 40
Internal Marks: 20
Time: 3 hours

UNIT-I

1. Introduction to Computers

Brief history of development of computers
Generations of computers
Types of components of a computer system
Basic components of a computer system
Memory RAM – ROM, and other types of memory.
Operating system
Need of software, types of software
Types of virus, virus detection and prevention
Binary number system

UNIT-II

2. Introduction to Windows

Using mouse and moving icons on the screen.
My computer, recycle bin, status bar.
Start menu selection, running an application
Window explorer to view files, folders and directories, creating and renaming of files and folders. Operating and closing of different windows, minimize, restore and maximize forms of windows.
Basic components of a window : Desktop, frame, Title bar, menu bar, status bar, scroll bars, using right button of the mouse.
Creating shortcut, basic windows accessories: power point presentation, notepad, paint, calculator, word pad, using clipboard.

UNIT-III

3. Introduction to Ms-office and word processor

Types of word processor
Creating and saving a documents, editing and formatting document including changing colour, size font, alignment of text.
Formatting paragraphs with line or paragraph spacing adding headers and footers, numbering pages.

92

Using grammar and spell check utilities, etc. printing document.
Inserting word art, clipart and pictures.
Page setting, bullet and numbering, borders, shading format painter
find and replace.
Inserting tables, mail merge.

UNIT-IV

4. Introduction to information and communication technology

Concept, importance, meaning and nature of information and communication technology.
Need of information and communication technology in physical education
Scope of ICT in education and physical education Teaching learning process, publication, evaluation, research administration. Paradigm shift in education due to ICT content with special reference to curriculum.
Role to teacher, methods of teaching, classroom environment, evaluation procedure. POP and WEB based E-mail, merits address, Basics of sending and receiving, E-mail, protocols, Mailing
list free e-mails services.

REFERENCES :

- ITL Education solution ltd. Introduction to information technology research and development wing-2006.
- Simmons Ian, computer dictionary BPB publications-2005.
- Pradeep K. Sinha and Prit; Sinha foundations computing BFB publications-2006.
- Douglas E. Comer, The internet Book, Purduce University, West Lafayette in 2005.
- V. Rajarman, fundamentals of computers, prentice hall of India, New Delhi-2000.
- B. Ram. Computer fundamentals, New age international publishers 2006.

B.P.E.S SEMESTER –IV
PAPER – II
BASIC PRINCIPLES OF SPORTS TRAINING

Max. Marks: 60
External Marks: 40
Internal Marks: 20
Time: 3 hours

UNIT-I

1.1. Introduction

1.1.1 Meaning and Definitions of sports training.
1.1.2 Meaning of terms : coaching, teaching, conditioning and training.
1.2 Aims and Tasks of sports training.
1.3 Systematization of sports training
1.3.1 Basic Training
1.3.2 Intermediate Training
1.3.3 High performance training

UNIT-II

2.1 Training Load :

2.1.1 Definition and Types of training load.
2.1.2 Features/Factors of Training Load.
2.2 Over Load

23

2.2.1 Meaning and types of over load
2.2.2 Causes of over load.
2.2.3 Symptoms of over load.

UNIT-III

3.1 Strength
3.1.1 Concept and types of strength
3.1.2 Methods of strength training.

3.2 Endurance
3.2.1 Concept and types of endurance.
3.2.2 Methods of endurance training
39 40

3.3 Speed
3.3.1 Concepts and classification of speed
3.3.2 Methods of developing speed abilities
3.3.3.1 Reaction speed
3.3.3.2 Speed of movement
3.3.3.3 Acceleration speed
3.3.3.4 Sprinting speed
3.3.3.5 Speed endurance

UNIT-IV

4.1 Technical Training
4.1.1 Definition of Technique and skill
4.1.2 Importance of Technique

4.2 Tactical Training
4.2.1 Concept of Tactics and Strategy
4.2.2 Methods of Tactical Training.

5.1. Planning
5.1.1 Concept of Training Plan.
5.1.2 Types of Training plan.

5.2 Periodization
5.2.1 Meaning and Importance of Periodization
5.2.2 Aim and Contents of Periods
5.2.3 Types of Periodization

REFERENCES :

Dick W. Frank, Sports Training Principles 4th Ed. (London : A & C Black Ltd.),2002.
Harre, D. Principles of Sports Training (Berlin : Sport Veulag), 1982.
Marveyev, L.P. Fundamentals of Sports Training (Moscow : Progress Publishers),1977.
Singh, Hardayal, Science of Sports Training (New Delhi : DVS Publications),1991.
Uppal, A.K. Principles of Sports Training (Delhi : Friends Publication),2001.
Tuder B. Bompa & Mihal C. Carera, Periodiation Training for Sports, Human Kinetics, 2005 (IInd Edition)
Yograj Thani, Sports Training, Sports publication 2003.
K. Chandra Shekar, Sports training, Khel Sahitya Kendra,2004.

(24)

B.P.E.S SEMESTER –IV
PAPER-III
RECREATION

Max. Marks: 60
External Marks: 40
Internal Marks: 20
Time: 3 hours

1. Introduction *UNIT- I*
Meaning, Definitions and characteristics of recreation
Importance of Recreation.
Misconceptions about Recreation
Scope of Recreation

2. Influence of recreation in social institutions *UNIT- II*
family
Education institutions
Community/Cultural
Religious organization

3. Planning for recreation *UNIT- III*
Planning criteria and objectives of recreation facilities.
Different types of indoor and outdoor recreation for urban and rural population.
Operation and maintenance of different recreation area and facilities
Sources of funding of recreational activities.

4. Programmes in recreation *UNIT- IV*
Classification of Recreational Activities
Indoor and outdoor activities
water activities
Cultural activities
Literary activities
Nature and outing
Social events
Adventure activities
Hobbies-Introduction to hobbies and types of hobbies
Agencies providing Recreation.

5. Camping and leadership

Aim, objectives and importance of camping.
Organization and types of camp.
Selection and layout of camp site.
Camping leadership
Types and functions of recreation leaders
Qualification, qualities and training and recreation leaders.

REFERENCES :

Bright Charles K. and Herold C. Meyer. Recreational test and readings. Eaglewood cliff, New Jersey Prentice Hall, I 1953.
Ness wed, M.H. and New Meyer E.s. Leisure and Recreation, New Yourk, Ronald Press.
Vannier Marybalen, Methods and Material in Recreation leadership Philadelphia,W.B. Sounders company.1959
Planning Facilities for Health Physical Education and recreation, Chicago, the Athletic institute, 1936.
Recreation areas : Their Design and equipments, New York : Ronal Press 1958,
Kran, R.G. Recreation and the schools : New York : Mac melon company.
Shivers J.S., Principles and practices of recreational services. London : Mac Melon Company 1964
Kledienst V. K. & Weston A the recreational sports programme prentice hall international Ic. London 1978.
Butler George introduction to community recreation (Mc Gram Hill Book Company 1976)
Dubey and Nayak Recreation Reston AP publishers, Jalandhar. Marrow GS Therapeutic Recreation Reston Publishi company 1976.
Kelly JR Leisure Prentice Hall Inc. Englwood Cliffs N.J. (1982).

B.P.E.S SEMESTER – IV
ADAPTED PHYSICAL EDUCATION
PAPER- IV

Max. Marks: 60
External Marks: 40
Internal Marks: 20
Time: 3 hours

UNIT - I

1. Introduction to Adapted Physical Education
Meaning and definitions
Aims, goals, & objectives
Need & importance of adapted physical education

UNIT - II

2. Classification of Disability
Physical disabilities
Causes
Functional Limitations
Characteristics
Mental Retardation
Causes
Characteristics
Functional Limitations
Visual Impairment
Causes

(96)

Characteristics
Functional Limitations
Hearing Impairment
Causes
Characteristics
Functional Limitations
Behavioral Disorders
Adjustment problems
Personality disorder
Modifications for teaching and programming in physical education and sports

UNIT- III

3. Adapted physical education programme
Guiding principles for adapted physical education programme (AAPHER Principles)
Physical Education program for disabled for
Elementary school
43 44
Middle school
High School
College & University level

UNIT-IV

4. Co-curricular Activities for disabled
outdoor programme for the disabled
Adventure based outdoor programme
Rhythm and dance activities
5.1 Rehabilitation
5.1.1 Aims and objectives of rehabilitation council of India.
5.1.2 Meaning of functional and occupational rehabilitation
5.2 Governmental Welfare Programme
5.2.1.1 Provision of Special rights and privilege for disabled through legislations.
5.2.1.2 Social welfare programme for disabled
5.2.1.3 Mass public education /Awareness programme
5.2.1.4 Education approach
5.2.1.5 Service approach
5.2.1.6 Legislative approach

REFERENCES :

Auxter,Byler, Howtting, Adapted Physical Education and Reactions,
Morbey-St. Lauis Mirrauri. Arthur G. Miller and James, Teaching Physical Activities to Impaired Youth, John Wilage & Sons Inc. Canada.
Ronal W. French, & Paul J. , Special Physical Education,
Charles E. Merrics Publishing Co. Edinburgh, Ohio. Arthur S.Daniles and Euily, Adapted Physical Education, Harpet & R.W. Publisher-New York.
Anoop Jain, Adapted physical Education, sports publications, Ashok Vihar, Delhi-52.

27

B.P.E.S SEMESTER – V
PAPER- I
SPORTS SOCIOLOGY

Max. Marks: 60
External Marks: 40
Internal Marks: 20
Time: 3 hours

UNIT-I

1. Concept of Sociology
1.1 Meaning, nature and scope of sociology
1.2 Methods of sociology and their relationship with other social sciences.
1.3 Effect of various social forces on personality development.
1.4 Sport – medium of socio-cultural change.

UNIT-II

2. Introduction to sports sociology
2.1 Meaning and scope of sports sociology
2.2 Sports sociology as a discipline
2.3 Sports as a social occurrence
2.4 Effect of appearance, sociability and specialization on sport participation

UNIT-III

3. Sports and society
3.1 Socialization through games and sports
3.2 Recreation and its scope through games and sports.
3.3 Sport as an element of society
3.4 Sport as an element of cultural development
3.5 Sport as an art.

UNIT-IV

4. Social factors concerning sports in society
4.1 Social stratification in sports
4.2 Demonstration in sports
4.3 Sport and women
4.4 Sport and children
4.5 Sport and older adults

REFERENCES :
Sharma, S.R., Sociological foundation in physical education and sports, friends publication, New Delhi.

28

□□Singh, Kawaljeet, Sociology of sports, Friends publication, New Delhi.
□□Sing, Bhupinder, Sports Sociology-An Indian perspective, Friends publication, New Delhi.
□□Yobu, A, Sociology of Sports, Friends publication, New Delhi.

B.P.E. SEMESTER-V
PAPER-II
METHOD OF PHYSICAL EDUCATION

Max. Marks: 60
External Marks: 40
Internal Marks: 20
Time: 3 hours

UNIT- I

1. Physical Educational Method :
1.1 Definitions – Scope and importance of method in Physical education:
1.2 Teaching Techniques in Physical Education
1.2.1 Lecturer Method
1.2.2 Command Method
1.2.3 Demonstration Method
1.2.4 Limitation Method
1.2.5 Project Method
1.2.6 Discussion Method
1.2.7 Group Directed Practice Method
1.3 Teaching Procedure in Physical Education :
1.3.1 Whole Method
1.3.2 Whole part whole method
1.3.3 Part whole method
1.3.4 Stage whole method

UNIT-II

2. Classification :-
2.1 Classification of pupils for routine physical Education activities and competitions
2.2 Various method of classification
2.3 Advantage and disadvantage of classification.

UNIT-III

Lesson Planning :
a) i) Types of lessons: Knowledge lesson, Drill lesson, skill lesson, Review lesson, Appreciation lesson.
ii) Planning and observation of Class- Room Teaching lesson.

29

a) Planning and observation of field Activity Teaching lesson.
b) Teaching aids-importance, Types and uses, Audio-Visuals, Charts, Models, Films, Black Board, etc.

UNIT-IV

4.1 Tournaments and competitions : Group competitions and their importance, Methods of organizing competitions types of tournaments, methods of conducting tournaments 4.2 Methods of conducting intra- Mural and Extra mural completions, games of law organization, organization of excursions.
5.1 Construction and marking of play field for various games, laying out of running's Track, construction of jumping pits preparing and markings of different play fields. The admeasurements and requirements.

B.P.E.SEMESTER-V

PAPER-III

REMEDIAL AND CORRECTIVE PHYSICAL EDUCATION

Max. Marks: 60
External Marks: 40
Internal Marks: 20
Time: 3 hours

UNIT-I

1.1 Meaning, importance and scope of posture education.
1.2 concept and classification of posture-
1.2.1 Correct and incorrect postue-
1.2.2 Static and dynamic posture-
1.2.3 Body type and posture-

UNIT-II

2. Postural Deformities :
A study of Physical defects in posture and the corrections to be arrived at – Kyphosis
Lordosis
Scolliosis
Flat foot
Bowed legs
Knocked knees
Corrective exercise
Assessment of posture-posture test.
Therapeutic exercise and their classification

UNIT-III

3.1 Sports Injuries :
3.1.1 Introduction to sports injuries
3.1.2 Role of trained personnel in the management of the sports injuries
3.2 Prevention injuries:
3.2.1 Factors causing sports injuries
3.2.2 Factors sports injuries
3.2.3 Complications of incomplete treatment

UNIT-IV

4.1 Common sport injuries and their immediate treatment

30

4.1.1 Sprain
4.1.2 Strain
4.1.3 Contusion and hecatomb
4.1.4 Dislocation
4.1.5 Fracture
4.2 Rehabilitation :
4.2.1 Definition objectives and scope
4.2.2 Effects and uses of the therapeutic modalities in
4.2.2.1 Cold therapy
4.2.2.2 Hot most
4.2.2.3 Infra Red
4.2.2.4 Contrast bath
4.2.2.5 Wax bath therapy
5.Massage
5.1 Brief history of massage.
5.2 Principles of application of Massage.
5.3 Classification of the manipulations used in massage and the effects of each such type on different systems of human body.
5.3.1 Stroking manipulation
5.3.2 Pressure manipulation
5.3.3 Percussion Manipulation

Reference:-

1. Corrective physical education by rathbone (J.1.H.B. Saunders and Co.)
2. Manual of message and movement by Prof. E.M.Naro (Faber & Faber)
3. Therapeutic exercises for body alignment and function by William Macllmond, Catherine Worthinghw (W.B.Saunders & Co.)
4. Message and Medical Gymnastics by M.V.Lace (J & A Churchhill Ltd.
5. Preventive and Corrective Physical Education by Stafford and Kelly (Ronald Press Co. New York)
6. Tests and Measurements by McCoiy and Young.

B.P.E.SEMESTER-V
PAPER-IV
TEST AND MEASUREMENT IN PHYSICAL EDUCATION

Max. Marks: 60
External Marks: 40
Internal Marks: 20
Time: 3 hours

1. History and Need: **UNIT-I**

(31)

1.1 History of measurement in physical education.
1.2 Meaning of test and measurement
1.3 Need for test and measurement in phy-education.
1.4 The use of test and measurement in phy-education.

UNIT-II

2. Criteria for selecting tests :
2.1 Validity
2.2 Reliability
2.3 Objectivity
2.4 Norms
2.5 Standard norms
2.6 Accuracy and interpretability

UNIT-III

3. Physical Fitness Test :
3.1 Strength Test
3.1.1 Fleshman's battery on basic fitness test
3.1.2 Physical fitness index
3.1.3 Sargen test
3.2 Motor Fitness Tests –
3.2.1 J.C.R. Test
3.2.2 National Physical efficiency test
3.3 Cardiovascular test-
3.3.1 Harward's Step test
3.3.2 Foster test
3.3.3 Copper's Twelve minuter Run and walk test

UNIT-IV

4. Sport skills test
4.1.1 Application of skill test.
4.1.2 Fundamental of measuring techniques in sports.
4.1.3 Standard activity tests Miler Volley ball test,
Johnson Baskaball ability test. Goal shooting test in hockey.

REFERENCES :

- Clarks H : Application of measurement of health physical education, prentice Hall. Inc. 1967.
- Larson L.A. & Yocom R.D. Measurement and Evaluation in Physical Health and Recreation Education St. Luis C.V.Mosby Co.
- Mathew, Donald: Measurement in Physical Education London, W.B. Saunders & Co.
- Neilson, N.P.: An elementary Course in Statistics Test and Measurement in Physical, California National Test, Polo Also.
- Harbens Singh : Teaching Hockey Through Testing, Karnal, Laxmi Sports Industries.
- Wilks, S.S.Elementary Statistical Analysis, Calcutta, Oxford and T.B.H. Pub.

32

B.P.E. SEMESTER-VI
PAPER-I
PROFESSIONAL PREPARATION IN PHYSICAL EDUCATION & SPORTS

Max. Marks: 60
External Marks: 40
Internal Marks: 20
Time: 3 hours

UNIT-I

1.1 Meaning Nature and Criteria of profession.
1.2 Physical Education as a profession.
1.3 Aims and objectives of Genral Education contribution of professional preparation to the purpose of education.
1.4 Forces and Factors affecting the policies and programmes of professional preparation educational, social, political, economical, religions etc.
1.5 Accreditation and Certification.

UNIT-II

2.1 Qualifications for teaching courses of professional preparation in physical education.
2.2 Specific qualifications for physical educatturs.
2.3 Teaching evaluation
2.4 Duties and services of physical education teachers.
2.4.1 Experience through movement education including games, sports and other activities.
2.4.2 Professional preparation programmes Health, safty, recreation, camping and outdoor education.
2.4.3 Coaching (d) conducting research.
2.4.4 Administrative functions (f) Measurement and Evaluation.
2.4.5 Community Responsibilities
2.4.6 Professional Leadership

UNIT-III

Role of central and state Government in professional preparation.
3.2 Role of non-official agencies in improving professional preparations.
3.3 Historical perspective of teachers training in physical education in India.

33

UNIT-IV

4.1 Allied subjects their meaning, concept and scope sports, psychology, sports sociology, sopts philosophy, sports, mechanics, kinesiology, physiology sports medicine, health education.

4.2 Sports and other field

4.2.1 Sports and politics

4.2.2 Sports and Culture

4.2.3 Sports and Economics (Commerce)

REFERENCES :

- Bucher, Wuest: Foundation of physical education and sport.
- Seidel Reseck : Physical education : An overview (2nd Edn)
- Richard S. Revenes : Foundation of physical education.

B.P.E. SEMESTER-VI

PAPER-II

EDUCATIONAL TECHNOLOGY

Max. Marks: 60

External Marks: 40

Internal Marks: 20

Time: 3 hours

UNIT-I

1. Introduction to Educational Technolgy :

1.1 Definition

1.2 Educative process

1.3 The Teacher of Yesterday & Today.

1.4 An outline of teaching method used then and now

UNIT-II

2. Teaching Aids :

Importance of Teaching Aids

Criteria for selecting teaching aids

Difference between teaching method and teaching aid

Broad classification to teaching aids

Audio Aids

visual Aids

Audio Visual Aids

Effectiveness of Edger Dale's cone classification.

UNIT-III

3. Advantage and suggestions for effective use of selected

(34)

ing aids — Teaching Aids
al
k Board — Verbal
ts — chock Board
els — charts
e Projector — models
r Head Projector — slide Projector
tion Picture
f Experiment and Projects.

- over Head Projector
- motion Picture
- Selfs Experiment and Projects

UNIT-IV

New Teaching Techniques and INNOVATIONS-II :

Micro Teaching (micro)
oncept and features of micro teaching. (concept)
micro teaching verses traditional teaching (micro)
teps in micro teaching - (steps)
Micro teaching skills (micro)
Limitation of Micro teaching (limitation)

5. Simulation Teaching :
5.1 Meaning of Simulation
5.2 Types of activities in simulation
5.3 Steps in simulation
5.4 Advantages of simulation
5.5 Limitations of simulation

REFERENCES :

- K Sivapath, A Panniselvan and S. Santhanam , Introduction to Educational Technology (New Delhi : Sterling Publishers Pvt. Ltd. 1981.
- Bhatia and Bhatia. The Principles and Methods of Teaching (New Delhi: Doaba House) 1959
- Walia J.S.Principles and Methods of Educatin (Paul Publishers Jallandhar), 1999
- Kochar, S.K.Methods and TEchniques of Teaching (New Delhi Jallandhar, Sterling Publishers Pvt. Ltd.), 1982.
- Lozman Cassidy and K Jackson, Methods in Physical educatin (W B.Saunders Company, Philadelphia and London), 1952.
- Singh, Ajmer and other Modern Text Book of Physical Education. Health and sports B.A.Part-I (Kalyani Publishers, Ludhiana), 2000
- Amita Bhardwaj, New Media of Educational Planning Sarup of Sons, New Delhi, 2003.

B.P.E. SEMESTER – VI
PAPER-III
OFFICIATING AND COACHING

Max. Marks: 60
External Marks: 40
Internal Marks: 20
Time: 3 hours

35

1.2 Components of fitness and their description
1.3 Components of wellness and their description
1.4 Significance of fitness and wellness in present scenario.
1.5 Fitness and wellness for life

UNIT – II FITNESS PROFILE, DEVELOPMENT AND MAINTAINENCE OF FOLLOWING

2.1 Types :- physical (cardio respiratory, strength, speed agility, flexibility, power, muscular endurance) health related (cardio-respiratory, flexibility, body composition, muscular strength and endurance) motor skill related (speed, power, agility, coordination, endurance, balance)
2.2 Principals of physical fitness
2.3 Benefits of fitness programme
2.4 Obesity (causes and prevention)
2.5 Weight management (role of diet & exercise in maintenance of ideal weight)

UNIT – III WELLNESS

3.1 Identifying dimensions of wellness, achieving and maintenance of wellness
- Adopting healthy & positive lifestyle.
- Identifying stressors and managing stress
- Staying safe & preventing injuries
- Knowledge of Nutrition & its implication on healthy lifestyle
- Factors leading to eating disorders
- Hazards of substance abuse (smoking, alcohol & tobacco)
- Adoption of spirituality principals & their remedial measures
- Yogic practices for achieving health and fitness
- Worthwhile use of leisure time.
- Sexuality – preventive measures for sexual transmitted diseases.
- Emphasis on proper rest &sleep.
- Prevention of cancer, cardio-vascular disorders &other diseases.

3.2 Relationship of wellness towards positive lifestyle
3.3 Benefits of wellness

UNIT – IV BEHAVIOR MODIFICATION

4.1 Barriers to change
4.2 Process of change (6 stages) SMART
4.3 Technique of change & smart goal setting.
4.4 Healthy lifestyle approach. (Introduction, prevention, and treatment of inactivity diseases)
5.1 Daily schedule based upon one's attitude, gender, age &occupation.
5.2 Basic – module: - Time split for rest, sleep, diet, activity & recreation.
5.3 Principles to achieve quality of life:- positive attitude, daily regular exercise, control over food habits & healthy hygienic practices.

REFERENCES

Fitness

- Anderson, B., Stretch Yourself for Health & Fitness, Delhi : UBSPD, 2002.
- Austin and Noble, Swimming For Fitness, Madras: All India Pub., 1997.
- Bean, Anita, Food For Fitness, London : A & C Block, 1999.
- Callno Flood, D.K., Practical Math For Health Fitness, New Delhi, 1996.
- Cox, Corbin, C.B & Indsey, R., Concepts of Physical Fitness, WC Brown, 1994.
- Difiore, Judy, Complete Guide to Postnatal Fitness, London : A & C Black, 1998.

37

Components of fitness and their description
Components of wellness and their description
Significance of fitness and wellness in present scenario.
Fitness and wellness for life

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Hazards of substance abuse (smoking, alcohol & tobacco)
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Yogic practices for achieving health and fitness
Worthwhile use of leisure time.
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Emphasis on proper rest &sleep
Prevention of cancer, cardio-vascular disorders &other diseases.
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- Anderson, B., Stretch Yourself for Health & Fitness, Delhi : UBSPD, 2002.
- Austin and Noble, Swimming For Fitness, Madras: All India Pub., 1997.
- Bean, Anita, Food For Fitness, London : A & C Block, 1999.
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- Difiore, Judy, Complete Guide to Postnatal Fitness, London : A & C Black, 1998.

37

Rules and their interpretations and duties of officials.

Squash Fundamental Skills
- Service- Under hand and Over hand
- Service Reception
- Shot- Down the line, Cross Court
- Drop
- Half Volley
- Tactics – Defensive, attacking in game
- Rules and their interpretations and duties of officials.

Tennis: Fundamental Skills.
- Grips- Eastern Forehand grip and Backhand grip, Western grip, Continental grip, Chopper grip.
- Stance and Footwork.
- Basic Ground strokes-Forehand drive, Backhand drive.
- Basic service.
- Basic Volley.
- Over-head Volley.
- Chop'
- Tactics – Defensive, attacking in game
- Rules and their interpretations and duties of officials.

Base Ball Fundamental Skills
- Player Stances – walking, extending walking, L stance, cat stance.
- Grip – standard grip, choke grip,
- Batting – swing and bunt.
- Pitching –

- Baseball : slider, fast pitch, curve ball, drop ball, rise ball, change up, knuckle ball, screw ball,
- Softball: windmill, sling shot,
- starting position: wind up, set.
- Fielding –
- Catching: basics to catch fly hits, rolling hits,
- Throwing: over arm, side arm.
- Base running –
- Base running: single, double, triple, home run,
- Sliding: bent leg slide, hook slide, head first slide.
- Rules and their interpretations and duties of officials.

Netball: Fundamental Skills
- Catching: one handed, two handed, with feet grounded, in flight.
- Throwing (different passes and their uses): one handed passes (shoulder, high shoulder, underarm, bounce, lob); two handed passes (push, overhead, bounce).
- Footwork: landing on one foot; landing on two feet; pivot; running pass.
- Shooting: one hand; two hands; forward step shot; backward step shot.
- Techniques of getting free: dodge and sprint; sudden sprint; sprint and stop; sprinting with change of speed.
- Defending: marking the player; marking the ball; blocking; inside the circle; outside the

(39)

DEPARTMENT OF COMPUTER SCIENCE, INSTITUTE OF ENGINEERING & TECHNOLOGY, KHANDARI CAMPUS
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Department of Computer Science

Institute of Engineering & Technology , Khandari Campus

Dr Bhimrao Ambedkar University, Agra

Programme, Programme Specific and Course Outcomes

(PO, PSO & CO)

MCA

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MCA
Program Outcomes (POs)

PO-1	Apply knowledge of Computing fundamentals, Computing specialization, Mathematics, and domain knowledge appropriate for the computing specialization to the abstraction and conceptualization of computing models from defined problems and requirements.
PO-2	Identify, formulate, research literature, and solve complex Computing problems reaching substantiated conclusions using fundamental principles of Mathematics, Computing sciences, and relevant domain discipline
PO-3	Design and evaluate solutions for complex computing problems, and design and evaluate systems, components, or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.
PO-4	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions.
PO-5	Create, select, adapt and apply appropriate techniques, resources, and modern computing tools to complex computing activities, with an understanding of the limitations.
PO 6	Understand and commit to professional ethics and cyber regulations, responsibilities, and norms of professional computir practice
PO-7	Demonstrate knowledge and understanding of computing and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO-8	Communicate effectively with the computing community, and with society at large, about complex computing activities by being able to comprehend and write effective reports, design documentation, make effective presentations, and give and understand clear instructions.
PO-9	Understand and assess societal, environmental, health, safety, legal, and cultural issues within local and global contexts, and the consequential responsibilities relevant to professional computing practice.
PO-10	Function effectively as an individual and as a member or leader in diverse teams and in multidisciplinary environments.
PO-11	Identify a timely opportunity and using innovation to pursue that opportunity to create value and wealth for the betterment of the individual and society at large.
PO-12	Recognize the need, and have the ability, to engage in independent learning for continual development as a Computing professional.

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MCA Programme Specific Outcomes (PSOs)	
PSO-1	To prepare graduates who will create systems through software development to solve problems in Industry domain areas.
PSO-2	To Prepare Graduates who will contribute to societal growth through research in their chosen field.
PSO-3	To prepare graduates who will perform both as an individual and in a team through good analytical, design and implementation skills.
PSO-4	To prepare graduates who will be lifelong learners through continuous professional development.

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ORDINANCES

Master of Computer Applications (MCA)- Two Year Course

Ordinances:

1. Master of Computer Applications (MCA) is a Two Year Degree Course divided into four semesters.
2. Each Academic session shall be divided into two semester viz. the autumn semester and the spring semester. Each semester shall consist of minimum 90 working days as per UGC (MHRD) norms.
3. First, Second and Third semesters shall have six courses each and Fourth semester shall consist of five courses. Additionally, each semester will consist of practical, seminar, tutorial/group discussion and the extracurricular activities.
4. For internal assessment of each course, there shall be three periodical tests during the semester concerned and best two tests shall be taken into consideration; the time allowed for each test shall be one hour and the interval between any two consecutive tests shall not be less than 15 days.
5. The periodical tests shall be conducted by the internal teacher concerned with the course during the semester concerned and the answer books shall be shown to the examinees.
6. The division of marks for internal assessment shall be as under:
   (a) First periodical test 20 Marks
   (b) Second periodical test 20 Marks
   (c) Third periodical test 20 Marks
   (d) Regularity/Seminar/Class Performance/Discipline/Extra Curricular Activities 10 Marks
7. MCA third semester Re-Exam can be conducted with the term examination of Fourth semester i.e. in the month of May/June of the academic session.
8. If the candidate fails to appear in any internal assessment test due to authorized medical ground, the Department/concerned subject teacher may re-conduct the particular test for that candidate.
9. At the end of each semester, there shall be a term examination of three hours duration of each course and the same shall carry 50 marks

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10. There shall be a practical examination at the end of each semester carrying 200 Marks.
11. Prior to the commencement of each term Examination there shall be preparation leave for not less than 7 days and not more than 10 days.
12. For each semester at least 50 percent of theory papers shall be set by the external examiner outside of the department. The remaining papers shall be set by the internal faculty of the department.
13. There shall be a project work after the end of terminal examination of second semester i.e. during the summer vacation. The project shall be completed under the guidance of an internal teacher of the department. The Viva-Voce of the project after summer vacation will be conducted by one external examiner jointly with the internal supervisor(teacher) who will act as internal examiner and another project during the fourth semester. The Viva-Voce of the project completed during the fourth semester will be conducted by internal teachers only.

14. The minimum qualifications for admission in MCA course shall be as under:

    (i) **Passed BCA/Bachelor degree in computer science/Engineering or Equivalent degrees.**

    OR

    Passed B.Sc./B.Com./B.A. with mathematics at 10+2 label or at graduation label (with additional bridge course as per the norms of concerned university).

    (ii) **The candidate must have at least 50% marks (45% marks in case of candidates belonging reserve category as per university norms) in the qualifying examination.**

15. A candidate who has been admitted to MCA course shall be required to attend and participate in all four semester examinations to be organized by the department.

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16.The marks shall be assigned as under:

Semester	Particulars	Marks	Courses	Total Marks
I	Internal Marks	50	06	300
I	External Marks	50	06	300
I	Practical	200	01	200
II	Internal Marks	50	06	300
II	External Marks	50	06	300
II	Practical	200	01	200
II	Project	200	01	200
III	Internal Marks	50	06	300
III	External Marks	50	06	300
III	Practical	200	01	200
IV	Internal Marks	50	05	250
IV	External Marks	50	05	250
IV	Practical	200	01	200
IV	Project	200	01	200
			Grand Total	3500

17. To pass a course, a candidate shall be required to secure, in each semester at least 40% marks in the examination of each courses, internal assessment and practical examination with an overall aggregate of 50% marks provided that a candidate shall not be entitled to be declared successful at the MCA examination unless he/she has secured at least 50% marks in the aggregate of all four semesters.

18. (a) If a candidate fails in more than 50% of theory papers of external examination of a year he/she has to re-appear in all the papers of that year.

(b) A Candidate who has been declared successful in the MCA examination shall be awarded MCA degree. If the candidate has secured 60% or more marks he/she awarded first division otherwise he/she shall be placed in second division. If a candidate has secured 75% or more marks in the aggregate of four semester it shall be mentioned in the degree that he/she has passed MCA examination with Distinction

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19 (a) If a candidate fails in a course in either internal assessment or external exam in any course of any semester, he/she may have the option to re-appear in the respective exam of that course:

(b) He/she may have the option to re-appear in external examination of that course and maximum up to three more attempts shall be permitted for a candidate.

(c) He/she may have the option to re-appear in the internal tests examination (periodical tests) and only one chance shall be given to him/her. He can give internal tests with the immediate next internal examination of the corresponding semester.

20. A candidate shall have to complete MCA within maximum period of four years. After four years he/she is not entitled to re-appear in any examination of the course.

21. A Candidate must pass internal examinations and possess 75% attendance to appear in the term semester examination.

22. All types of the fee payable by MCA student shall be as per the university rules/norms.

23. Each semester will consist of the following course and each of the course is allotted the credits under **CBCS (Choice Based Credit System)** as given below:

S.No.		Course	Nature	Credit			Tot. Credit	Sem. Credit
1.		**First Semester**			I			
			Core/Op.El	L	T	P		
	C-101	COA	Core	03	01	00	04	
	C-102	C programming and Data Structure	Core	03	01	00	04	
	C-103	Human Values, Professional Ethics and soft skills	Core	04	00	00	04	25
	C-104	Software Engineering	Core	03	01	00	04	
	C-105	Operating System Concepts	Core	03	01	00	04	
	C-106	Discrete Mathematics	Core	03	00	00	03	
	C-107	Practical		00	00	02	02	
2.		**Second Semester**			II			
	C-201	Computer Communication Network	Core	02	01	00	03	
	C-202	OOPS Concepts	Core	02	01	00	03	
	C-203	Artificial Intelligence	Core	03	01	00	04	
	C-204	Theory of Computation	Core	03	01	00	04	25
	C-205	Open Elective-1	O.E.	03	00	00	03	
	C-206	DBMS	Core	03	00	00	03	
	C-207	Project (Summer Training)		00	00	02	02	
	C-208	Practical		00	00	03	03	

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3.		**Third Semester**	**III**					
	C- 301	Computer Graphics & Image Processing	Core	03	01	00	04	25
	C- 302	Open Elective-2	O.E.	02	01	00	03	
	C- 303	Open Elective-3	O.E.	02	01	00	03	
	C- 304	Data ware Housing & Data Mining	Core	03	00	00	03	
	C- 305	Design and Analysis of Algorithm	Core	03	00	00	03	
	C- 306	Optimization Techniques	Core	02	01	00	03	
	C- 307	Mini Project		00	00	02	02	
	C- 308	Practical		00	00	04	04	
4.		**Fourth Semester**	**IV**					
	C- 401	Soft Computing	Core	03	00	00	03	25
	C- 402	Compiler Design	Core	03	00	00	03	
	C- 403	Open Elective-4	O.E.	02	01	00	03	
	C- 404	Mobile Computing	Core	03	00	00	03	
	C- 405	Open Elective-5	O.E.	02	01	00	03	
	C- 406	Practical		00	00	04	04	
	C- 407	Project		00	00	06	06	
							Total	**100**

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List of Open Electives Subjects:

(i) Statistical Computing
(ii) . Net Technology using C # / PHP
(iii) Python Programming
(iv) Network Security
(v) Advanced Computing Techniques
(vi) Java and PHP
(vii) Parallel Processing
(viii) Distributed System
(ix) Bio-informatics
(x) Quantum Computing
(xi) Machine Learning
(xii) Cloud Computing

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Course Outcomes (Cos)

C- 101Computer Organization & Architecture (COA)

Subject Code: C101	Computer Organization & Architecture (COA)	L.T.P Model	CREDIT- 4

Course outcomes (CO's)-After the completion of this course students will be able to

CO1: Recall and describe computer organization and architecture concepts, Explain number systems, coding schemes, and basic computer components.
CO2: Understand digital information representation, binary signals, and Boolean algebra principles. Interpret memory organization, hierarchy, and different memory technologies.
CO3: Apply arithmetic operations, complements, and Boolean algebra to solve problems. Design and analyze digital combinational and sequential circuits.
CO4: Analyze coding schemes, error detection, and combinational/sequential circuit behavior. Evaluate CPU control unit designs, pipelining impact, and RISC/CISC architectures.
CO5: Evaluate memory organization, I/O subsystems, and data transfer techniques.

Syllabus

Unit I

Discrete Information, Digital Information, Binary Signal, Basic Computer Architecture, Number System (Binary, Octal, Decimal, Hexadecimal), Arithmetic, Compliments, subtraction with 1's and 2's Compliments, Binary coded decimal repetition, Expl-3.2, 4.2, 1.8,-2, -1, legions coding, prairie code, error detection & correction, reflected codes, hamming distance, logic Gates(AND, OR, NOT). Boolean Algebra, Postulates, theorems, duality, De-Morgan's theorem, Boolean Functions and their implementation using logic gates, Min-term, Max-term, Standard form , Algebraic manipulations, different lines operators(X-OR, NOR etc.), Simplification methods, k-map, Don't care conditions, Logical implementation 4s in 3 NAND, NOR, AND, OR, Gates, Dogmatic from a tabular method.

Unit II

Digital Combinational Circuit design, syndication problem simulation, Half Adder, Full Adder, Subtractor, Code Conversion Circuit, Multilevel NAND & NOR implementation, circuit analysis, conversion of the circuit, EX-OR equivalence, Parity generator & Checker circuit. LSI & MSI circuit design, Binary Parallel Adder, BCD Adder, Magnitude Comparator, Decoder, BCD Decoder, Encoder, and Use of LSI & MSI for the Boolean Function implementation

Unit III

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Introduction to Sequential Logic Circuit, Synchronous Sequential Circuit, Flip-Flops(S-R, D,T, J-K), edge Trigger, Master slave flip flop, FFS conversion, timing sequential diagram, analysis as sequential circuit, state table, state diagram & state equation, design as sequential circuit, unused states, self-starter circuit design as count ion, design with state equation, register, parallel loading in registers, implementation of Boolean function with registers, Shift registers, Ripple Counters, BCD counter, ICs of Ripples asynchronous as counters, Johnson counter, Ring counter.

Unit IV

Basic functional blocks of a computer: *CPU, Memory, I/O subsystems, Control unit*, Instruction set codes, format, Direct & Indirect Addressing, Instruction cycle, Interpretation of instructions, Registers, Common bus system.

Unit V

CPU Control Unit Design: Hardwired vs Micro programmed approaches, RISC vs CISC, Pipelining, Memory System Design: Memory technologies, memory organization, memory hierarchy, Peripheral Devices: I/O sub systems, Data Transfer Techniques (Programmed I/O, Interrupt Driven, DMA), Handshaking

List of Referenced Books:

1. Computer System Architecture by Morris Mano
2. Digital Logic Design by Morris Mano
3. Computer Architecture: Principles and Practice" by William Stallings and David O. Peterson.

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C- 102 C- Programming & Data Structure

Subject Code:C-102	C- Programming & Data Structure	L.T.P Model	CREDIT-4

Course outcomes (CO's)-After the completion of this course students will be able to

CO1: Recall and describe the fundamental concepts of programming, flowcharts, and data structures. Explain the review of C programming, including data types, input/output statements, and control structures.
CO2: Understand the logic behind flowcharts and the fundamentals of data structures and algorithms. Interpret the concepts of pointers, arrays, and different types of linked lists.
CO3: Apply programming concepts to solve problems using control structures, loops, functions, and parameters. Implement and manipulate arrays, stacks, queues, and priority queues using different data structures.
CO4: Analyze and evaluate the efficiency and performance of different data structures and algorithms. Evaluate the use of recursion and loop nesting in problem-solving.
CO5: Critically evaluate the advantages, disadvantages, and trade-offs of different data structures and algorithms. Evaluate and compare the efficiency and effectiveness of different sorting and searching algorithms..

Syllabus

Unit I

Introduction to program, Flow chart, Data Structures and Algorithms. Review of C Programming, Data Types, Input andOutput statements. If statements, switch statements.

Unit II

Recursion, looping statements, for, while and do while statements. Loop nesting. Block statements, functions, return data type and parameters. Pointers concepts. Arrays Operations, single and Multi-dimensional array Representation in memory.

Unit III

Stacks: Stack as an Abstract Data Type, Primitive Operationsand Implementing Stack Operations using Arrays, Infix, Postfix and Prefix: Definitions, Evaluation and Conversions. Queues: Queue as an Abstract Data Type, Operations, Implementation using Arrays, Types of Queues, circular Queue applications, priority queue.

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Unit IV

Linked List: singly linked list, Circular Lists: Insertion, Deletion and Concatenation Operations, Doubly Linked Lists, Multiply linked lists, applications, Implementation of Stacks, Queues and priority Queues using Linked Lists, Concepts of Trees and Binary Trees - Definitions and Terminology, representation of Trees, Binary Tree, tree traversals, binary search tree.

Unit V

Sorting: General Background: Bubble Sort, Selection Sorting, Insertion sort, Shell Sort and Quick Sort, Heap Sort.

Searching: Linear and Binary Searching, graph and its representation.

List of Referenced Books

1. Data Structures and Algorithms – Concepts, Techniques and Algorithms by G.A.V.Pai , Tata McGraw Hill Publishing

2. Data Structures Using C by YaddishLangsam, Moshe J. Augenstein and Aaron M.Tanenbaum, Prentice Hall Of India (Low priced Edition)

3. Data Structures using C by E. Balagurusamy, McGraw Hill Education India Pvt Limited

4. Data Structures, Algorithms and Applications with C++, Sahani Mc-Graw Hill.

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C-103: Human Values, Professional Ethics & Soft Skills

Subject Code: C-103	**Human Values, Professional Ethics & Soft Skills**	L.T.P Model	CREDIT-4

Course Outcomes (CO's): After the completion of this course the students will be able to

CO1: Recall and describe concepts: professional ethics, corporate social responsibility, MIS, and entrepreneurship. Define and explain: ethics-corporate excellence relationship, Indian workplace values, and entrepreneurship.
CO2: Understand: nature of professional ethics, effective communication principles, and different types of information systems.
CO3: Apply: effective communication principles, decision-making tools, and entrepreneurship knowledge.
CO4: Analyze arguments for and against social responsibility of business. Evaluate the role of MIS, decision support systems, and artificial intelligence systems.
CO5: Synthesize: traits of entrepreneurs and navigate different types of business organizations.

Syllabus

Unit –I

Professional Ethics: - An Overview-Concept, Nature, Indian values for the workplace, work-life balance, Relation between Ethics and corporate Excellence, Corporate Social Responsibility – Social Responsibility of business with respect to different stakeholders, Arguments for and against social responsibility of business.

Unit-II

Soft Skills: - Meaning and objective of business communication, communication models and process, Modern forms of communication, Principles of effective communication, Group discussion, Mock Interviews, Seminar, Individual and group Presentation, interviewing skills, writing resume and Letter or application.

Unit-III

Human Values: - Need Basic Guideline and process for Vales Education, Understand Harmony in the Human being, Harmony in myself understanding human being as a co-existence of the sentiments 'I' and the material 'Body', understanding Harmony in the family and society, harmony in human-human relationship, understand the harmony in the nature, Interconnectivity and mutual fulfilment among the four orders of nature-recyclability and self-regulation in nature. Holistic perception of Harmony at all levels of existence.

Unit-IV

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MIS (Information System): - Concept and definition, Role of MIS, MIS-Business Planning, Decision making concept, Method, tools and procedures, organizational Decision making, Management of quality in the MIS, organization development and implementation of the MIS, Decision Support System (DSS) concept and Philosophy, DSS Deterministic System, Artificial Intelligence (AI) system, Knowledge based expert system (KBES), Transaction Processing system(TPS), Enterprise Resources Planning (ERP) system.

Unit -V

Entrepreneurship-Meaning and Concept of entrepreneurship, Traits of Entrepreneur, Entrepreneurial Development, Search for business idea, transformation of business idea into reality, plant layout and plant location, Significance and role of environment infrastructural network, types of organization-sole proprietorship, partnership, joint stock company, co-operative organization, their merits.

List of Reference Books:

1. Management Information System by A. O Bryan
2. ERP by U. Nag
3. Human Values and Professional Ethics" by R.S. Naagarazan

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C-104: Software Engineering (Open Elective)

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Course Outcomes (CO's): After the completion of this course the students will be able to

Subject Code: C-104	**Software Engineering (Open Elective)**	L.T.P Model	CREDIT-4
CO1: Understand software engineering concepts, components, characteristics, and SDLC models. Identify software engineering processes, quality attributes, and their importance in software development.			
CO2: Interpret and explain software requirement specifications (SRS) and requirement engineering processes.			
CO3: Apply software design concepts, architectural principles, and strategies for software development. Utilize software measurement and metrics techniques, testing strategies, and techniques for software quality.			
CO4: Analyze software maintenance categories, cost considerations, and estimation methods.			
CO5: Evaluate the importance of software maintenance, cost considerations, and the role of CASE tools.			

Syllabus

Unit-I:

Software Engineering, Software Components, Software Characteristics, Software Crisis, Software Engineering Processes, Software Quality Attributes. Software Development Life Cycle (SDLC) Models: Water Fall Model, Prototype Model, Spiral Model, Evolutionary Development Models, Iterative Enhancement Models.

Unit-II:

Software Requirement Specifications (SRS) Requirement Engineering Process: Analysis, Documentation, Review and Management of User Needs, Feasibility Study, Information Modeling, Data Flow Diagrams, Entity Relationship Diagrams, Decision Tables, SRS Document, IEEE Standards for SRS. Software Quality Assurance (SQA): Verification and Validation, SQA Plans, Software Quality Frameworks, ISO 9000 Models, SEI-CMM Model.

Unit-III:

Software Design Basic Concept of Software Design, Architectural Design, Low Level Design: Modularization, Design Structure Charts, Pseudo Codes, Flow Charts, Coupling and Cohesion Measures, Design Strategies: Function Oriented Design, Object Oriented Design, Top-Down and Bottom-Up Design. Software Measurement and Metrics: Various Size Oriented Measures, Function Point (FP) Based Measures, Cyclomatic Complexity Measures: Control Flow Graphs, UML Diagrams

Unit-IV:

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Software Testing, Unit Testing, Integration Testing, Acceptance Testing, Regression Testing, Testing for Functionality and Testing for Performance, Top-Down and Bottom-Up Testing Strategies, Alpha and Beta Testing of Products. Static Testing Strategies: Formal Technical Reviews (Peer Reviews), Walk Through, Code Inspection, Software Reliability Models, Basic Concept of Goel-Okumoto Model

Unit-V:

Software Maintenance,Categories of Maintenance: Preventive, Corrective and Perfective Maintenance, Cost of Maintenance, Software Re-Engineering, Reverse Engineering, Overview of CASE Tools. Estimation of Various Parameters such as Cost, Efforts, Schedule/Duration, Constructive Cost Models (COCOMO).

List of Referenced Books:

1. R. S. Pressman, Software Engineering: A Practitioners Approach, McGraw Hill.
2. Rajib Mall, Fundamentals of Software Engineering, PHI Publication.
3. K. K. Aggarwal and Yogesh Singh, Software Engineering, New Age International Publishers.
4. Pankaj Jalote, Software Engineering, Wiley.
5. Ian Sommerville, Software Engineering, Addison Wesley.

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C–105: Operating System Concepts

Subject Code: C-105	Operating System Concepts	L.T.P Model	CREDIT-4

Course Outcomes (CO's): After the completion of this course the students will be able to

CO1: Understand operating system evolution, types, process management, scheduling, memory allocation, and secondary memory management.
CO2: Comprehend different views of operating systems, process states, thread mapping, and memory allocation schemes
CO3: Apply scheduling algorithms to evaluate performance, apply memory management techniques like paging and segmentation, and implement disk scheduling algorithms.
CO4: Analyze process management, memory fragmentation, deadlock detection, prevention, and avoidance strategies. Analyze disk scheduling algorithms based on seek time, rotational delay, and evaluate file system attributes.
CO5: Evaluate scheduling algorithm performance, analyze memory utilization, and evaluate deadlock prevention strategies.

Syllabus

UNIT I-

Introduction: Evolution Of Operating System, Types Of Operating System, Distributed Operating Systems, Network Operating Systems, Real Time Operating Systems (Hard & Soft), Different Views of Operating System: User's View, System's View, System Calls, Command Interpreter.

Unit II-

Processes: Process Concept, Process Management, PCB, Different States Of a Process, Scheduling Algorithms: Preemptive and Non Preemptive Algorithms, (FCFS, SJF, Priority, Round Robin, SRTF, Second Chance, Clock), Multilevel priority, Performance Evaluation, Threads: Introduction, User Level, Kernel Level, Mapping, Thread Library, Inter Process Communication And Synchronization, Classical IPC Problems, Mutual Exclusion, Critical Section, Concurrency, Semaphores, Monitors, Messages.

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Unit III-

Memory Management: Introduction, Memory Allocation Schemes: Contiguous & Non Contiguous, Swapping, Fragmentation: External & Internal, Compaction, Virtual Memory Management, Paging, Hit, Miss, Evaluate Effective Access Time, Page Replacement Algorithms (FIFO, Optimal, LRU, NRU), Demand Paging, Inverted Page Table, Segmentation, Thrashing.

Unit IV-

Secondary Memory Management: Disks, Hardware, Seek Time, Rotational Delay, Data Transfer Time, Disks Scheduling Algorithms (FCFS, SSTF, Scan, C-Scan, C-Look), Track-At-A-Time. Deadlock: Detection, Prevention, Avoidance, Banker's Algorithm.

Unit V-

File Systems: Files, Attributes, Operations, Directories: Operations, Structure, Security & Protection Mechanism, Input /Output, I/O Hardware, Devices, Device Controllers, DMA, I/O Software (User Level, Kernel Level, Hardware Level), Interrupt Service Routine.

List of Referenced Books

1. Operating System by Peterson, PHI
2. Operating System by William Stallings
3. Operating System Concepts" by Abraham Silberschatz, Greg Gagne, and Peter B. Galvin.

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C-106: Discrete Mathematics

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Subject Code: C-106	**Discrete Mathematics**	L.T.P Model	CREDIT- 3

Course Outcomes (CO's): After the completion of this course the students will be able to

CO1: Understand the principles and concepts of mathematical logic, relations, functions, matrices, recurrence relations, and graph theory.
CO2: Apply mathematical logic to solve problems and prove theorems using techniques like normal forms, quantifiers, and automatic theorem proving.
CO3: Analyze and evaluate the properties and characteristics of different types of matrices, recurrence relations, and graph structures.
CO4: Design and develop solutions for problems involving relations, functions, matrices, recurrence relations, and graph theory.
CO5: Assess and evaluate the validity and consistency of logical statements, proofs, and solutions.

Syllabus

UNIT I

Mathematical Logic: Statements and notations, Connectives, Well-formed formulas, Truth Tables, tautology, equivalence implication, Normal forms, Quantifiers, universal quantifiers. Predicates: Predicative logic, Free & Bound variables, Rules of inference, Consistency, proof of contradiction, Automatic Theorem Proving.

UNIT II

Relations: Properties of binary Relations, equivalence, transitive closure, compatibility and partial ordering relations, Hesse diagram. Functions: Inverse Function, Composition of functions, recursive Functions, Lattice and its Properties, Pigeon hole principles and its application.

UNIT III

Linear Algebra & Matrices

Matrices: Types of matrices, Elementary Transformation, Rank, Eigen Values & Eigen Vectors, Vector Space.

UNIT IV

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Recurrence Relations: Generating Functions, Function of Sequences, Calculating Coefficients of generating functions, Recurrence relations, Solving recurrence relation by substitution and Generating functions, the method of Characteristic roots, solution of non homogeneous Recurrence Relations.

UNIT V

Graph Theory: Representation of Graphs, DFS, BFS, Spanning Trees, Planar Graphs. Graph Theory and Applications, Basic Concepts, Isomorphism and Sub graphs, Multi graphs and Euler circuits, Hamiltonian graphs, Chromatic Numbers.

List of Referenced Books

1. Mathematical Foundation of Computer Science – ShahnazBathul, PHI.

2. Elements of Discrete Mathematics- A Computer Oriented Approach,C.L.Liu, D.P. Mohapatra,3edition,TMH.

3.Discrete Mathematics for Computer Scientists & Mathematicians, second edition, J.L.Mott, A. Kandel, T.P. Baker, PHI

4. Discrete and Combinatorial Mathematics- An Applied Introduction-5th Edition– Ralph. P.Grimaldi, Pearson Education.

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C-107: Practical -Lab based on C & Data Structure

Subject Code: C-107	**Lab based on C & Data Structure**	Practical	CREDIT-2

Course Outcomes (CO's): After the completion of this course the students will be able to

CO1: Write, compile, debug and execute programs in a C programming environment.
CO2: Write programs that incorporate use of variables, operators and expressions along with data types.
CO3: Write programs for solving problems involving use of decision control structures and loops.
CO4: Write programs that involve the use of arrays, structures and user defined functions.
CO5: Write programs using graphics and file handling operations.

List of Lab Practicals

1. Linked List implementation using C program
2. C program to display a Linked List in Reverse
3. C program to Reverse only First N Elements of a Linked List
4. Merge sort for single linked lists
5. Delete keys in a Linked list using C program
6. Reverse a Linked List in groups of given size using C program
7. Pair wise swap elements in a linked list using C program
8. C program to find Union of two single Linked Lists
9. Find intersection of two linked lists using C program
10. Append Last N Nodes to First in the Linked List
11. Eliminate duplicates from Linked List using C program
12. Find a Node in Linked List using C program
13. C program to convert a Binary Tree into a Singly Linked List by Traversing Level by Level
14. Count the number of occurrences of an element in a linked list using recursion
15. Count the number of occurrences of an element in a linked list without using recursion

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16. Find the length of a linked list using recursion
17. Find the length of a linked list without using recursion
18. Print the Alternate Nodes in a Linked List using Recursion
19. Print the Alternate Nodes in a Linked List without using Recursion
20. Implement Circular Doubly Linked List in C program
21. Convert a given singly linked list to a circular list in C program
22. Find the largest element in a doubly linked list in C program
23. Interchange the two adjacent nodes in a given circular linked list in C program
24. Convertla given binary Tree to Doubly Linked List (DLL)
25. Clone a linked list with next and random pointer using C program
26. C program to implement a STACK using array
27. STACK implementation using with Linked List using C program
28. STACK implementation using Array with PUSH, POP, and TRAVERSE operations using C program
29. STACK implementation using C structure with more than one item
30. STACK implementation using C class with PUSH, POP and TRAVERSE operations
31. C program to reverse a string using stack
32. Check for balanced parentheses by using Stacks (C program)

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MCA II SEMESTER

C-201: Computer Communication Network

Subject Code: C-201	**Computer Communication Network**	L.T.P Model	CREDIT-3

Course Outcomes (CO's): After the completion of this course the students will be able to

CO1: Understand computer network concepts, advantages, topologies, and transmission modes. Explain layered protocols, OSI model, LAN attributes, and protocols.
CO2: Apply multiplexing concepts and analyze switching, routing, and signals.
CO3: Analyze IP, TCP, UDP, and application layer protocols' features and functionality.
CO4: Identify and troubleshoot network-related issues and solve problems in switching, routing, and signal transmission.
CO5: Recognize and implement security and privacy best practices in computer networks.

Syllabus

Unit I

Introduction to Computer network, Distributed System, Advantages of Networks, Point to Point and Multi Drop Circuit, Network Topologies- Star, Ring, Tree, Bus, Mesh, Synchronous & Asynchronous Transmission, Serial & Parallel Transmission, Simplex, Half Duplex, Full Duplex Transmission Modes.

Unit II

Wide Area network, Local Area Network, Multiplexing: Time Division Multiple Aces, Time Division Multiplexing (TDM), Frequency Division Multiplexing (FDM), Connection Oriented and Connection Less Networks, Goals of Layered Protocols, Communication between Layers, Introduction to the OSI Reference Model, Data transmission in the OSI model.

Unit III

LANs, Primary attributes of LANs, Broad band and base band LANs, LAN Topologies and protocols CSMA/CD, Token Ring, Token Bus, Metropolitan Area Network & ANSI (FDDI) Fiber Distributed Data Interface, and Aloha Protocol- Pure & Slotted

Unit IV

Switching: Message, Packet, Circuit, Routing: Centralized, Distributed, Static, Adaptive, Signals: Analog & Digital, Bit Rate & Baud Rate.

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Unit V

Polling And Selection .Protocols: The meaning of polling selection protocols, Character and Bit Oriented protocols binary synchronous high level Data Link Control (HDLC), HDLC Frame format code transparency and synchronization, Sliding Window Protocol, Frame Format, Go-Back-n- Protocol selective repeat protocol.

Unit VI

TCP\IP and Internetworking concept of ports and sockets IP address structure Major features of IP, IP data gram major IP Services TCP Major features of TCP, TCP Segment UDP (User Data gram Protocol), Application Layer Protocol- TELNET, TFTP, FTP.

List of Referenced Books

a) Computer Network by Tannenbaum
b) Computer Network by Frozen

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C-202: OOPS Concept's

Subject Code: C-202	**OOPS Concept's**	L.T.P Model	CREDIT-3

Course Outcomes (CO's): After the completion of this course the students will be able to

CO1: Understand the concepts and principles of object-oriented programming (OOP) and Java fundamentals.
CO2: Apply OOP concepts to solve programming problems using Java, including class and object concepts, inheritance, interfaces, and inner classes.
CO3: Evaluate the usefulness of OOP development and Java programming for software design and development.
CO4: Collaborate with peers on programming tasks, sharing knowledge and best practices, and participating in code reviews..
CO5: Demonstrate ethical conduct and professionalism in software development, adhering to coding standards and best practices..

Syllabus

Unit I

Introduction: Modelling Concepts and Class Modelling: What is Object orientation? What is OO development? OO Themes; Evidence for usefulness of OO development; OO modelling history. Modelling as Design technique: Modelling; abstraction; The Three models. Advanced object and class concepts; Association ends; N-ary associations; Aggregation; Abstract classes; Multiple inheritance; Metadata; Reification; Constraints; Derived Data; Packages.

Unit II

Basic programming in C++ using Class & Object, Inheritance, Polymorphism and Templates and Exception Handling,Class Modelling: Object and Class Concept; Link and associations concepts.

Unit III

Introduction to OOP and java fundamentals:OOP in Java – Characteristics of Java – The Java Environment – Java Source File Structure – Compilation. Fundamental Programming Structures in Java – Defining classes in Java – constructors, methods -access specifiers – static members -Comments, Data Types, Variables, Operators, Control Flow, Arrays , Packages.

Inheritance: Super classes, sub classes, protected members, constructors in sub classes- the Object class, abstract classes and methods, final methods and classes. Interfaces, defining an

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Khandari Campus Agra-282002

interface, implementing interface, differences between classes and interfaces and extending interfaces, Objdct cloning, inner classes, ArrayLists, Strings.

Unit IV

Event driven programming: Graphics programming, Frame Components, working with 2D shapes, Using color, fonts, and images, Basics of event handling, event handlers, adapter classes, actions, mouse events, AWT event hierarchy,**Multithreading and generic programming:** Differences between multi-threading and multitasking, thread life cycle, creating threads, synchronizing threads, Inter-thread communication, daemon threads, thread groups, Generalization and Inheritance; A sample class model; Navigation of class models; Advanced Class Modelling.

Unit V

Introduction to Swing, layout management, Swing Components ,Text Fields , Text Areas, Buttons, Check Boxes – Radio Buttons Lists- choices, Scrollbars, Windows Menus ,Dialog Boxes. JDBC Introduction.

List of Referenced Books

1. Michael Blaha, James Rumbaugh: Object Oriented Modelling and Design with UML,2nd Edition, Pearson Education,2005
2. Balaguriswami : OOPs Programming PHI publication.

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C–203: Artificial Intelligence

Subject Code: C-203	**Artificial Intelligence**	L.T.P Model	CREDIT-4

Course Outcomes (CO's): After the completion of this course the students will be able to

CO1: Recall and recognize the fundamental concepts and terminology of Artificial Intelligence. Identify the different techniques and applications of AI, such as game playing, robotics, and expert systems.
CO2: Understand the knowledge representation models, including semantic nets, frame structures, and clause form representation.
CO3: Apply search algorithms like BFS, DFS, and heuristic search methods to solve problems. Utilize backward reasoning, resolution, and rules of inference for problem-solving in AI.
CO4: Analyze the characteristics and limitations of different AI techniques and algorithms.
CO5: Design AI systems or components using appropriate techniques and algorithms. Develop rule-based deduction systems and knowledge representation models for specific problem domains.

Syllabus

Unit I

Introduction, problem domain of AI, AI techniques, task, game playing, theorem proving, robotics, reception and speech recognition, NLP, expert system, criteria of success, level of modelling, state space representation, problem description.

Unit II

Search space problem, state space, water jug problem, 8-puzzle problem, travelling salesman problem, production system, control strategy, BFS, DFS, iterative problem, characteristics, commutative production system, heuristic search method, A* problem, and –or graphs, hill climbing, constraint satisfaction, mean max search, alpha-beta cut off.

Unit III

Knowledge representation issues and characteristic, model, representation mapping, types of knowledge representation model, first order predicate logic, WFF, predicate logic in AI, back ward reasoning method, resolution, rules of inference, modus pones, clause form representation, unification, questioning and answering.

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Unit IV

Natural deduction and weak slot, filler structure, rule base system, deficiency in clause form representation, forward rule base deduction system, representation of fact, rule and goal, wff in AND – OR graph representation, unify composition and answer extraction, instance representation, class inclusion and membership, property inheritance, semantic nets, partition semantic nets, presentation of wffs of predicate logic in semantic net, frame structure, regular class and media classes, property inheritance algorithms.

Unit V

Handling uncertainty and fuzzy logic, probabilistic reasoning, methods of handling uncertainty, reasoning of AI , fuzzy logic characteristic, its properties and operations, fuzzy sets and fuzzy systems, fuzzy rules and fuzzy inference system, Case study: Mycin

List of Text Book Recommended:

(i) Artificial Intelligence by Ritch and Knight
(ii) Artificial Intelligence by Elen

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C-204: Theory of Computation (TOC)

Subject Code: C-204	Theory of Computation (TOC)	L.T.P Model	CREDIT-4

Course Outcomes (CO's): After the completion of this course the students will be able to

CO1: Recall the theory of automation, including DFA, NFA, regular expressions, and finite automata. Remember the formal languages, phrase structured grammars, and Chomsky classification of languages.
CO2: Understand the concepts and descriptions of automation, formal languages, and context-free grammars. Grasp the equivalence of different automata models and regular expressions.
CO3: Apply the concepts of finite automata and regular expressions to solve problems in automation. Use pushdown automata for parsing and language recognition tasks.
CO4: Analyze the properties and closure properties of formal languages and regular sets.
CO5: Evaluate the efficiency and effectiveness of different automaton models for language recognition.. Evaluate the complexity and decidability of problems in automata theory.

Syllabus

UNIT-I

Theory of Automation : Definition, description, DFA,NFA, Transition systems,2DFA, equivalence of DFA & NDFA, Regular expressions, regular grammar, FSM with output (Mealy and Moore models), Minimization of finite automata.

UNIT-II

Formal Languages : Definition & description, Phrase structured grammars & their classification, Chomsky classification of languages, closure properties of families of language, regular grammar, regular set & their closure properties, finite automata, equivalence of FA and regular expression, equivalence of two way finite automata, equivalence of regular expressions.

UNIT-III

Context-Free Grammar & PDA : Properties unrestricted grammar & their equivalence, derivation tree simplifying CFG, unambiguous CFG, Productions, normal forms for CFG, Pushdown automata, 2 way PDA, relation of PDA with CFG, Determinism & Non determinism in PDA & related theorems, Parsing and pushdown automata.

UNIT-IV

Turing Machine : Model, design, representation of TM, language accepted by TM, universal Turing machine, determine & non-determinism in TM, TM as acceptor/generator/algorithms, multi- dimensional, multi-tracks, multi-tape, Two way infinite tape, multi-head, Halting problems of TM.

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Khandari Campus Agra-282002

UNIT-V

Computability: Concepts, Introduction to complexity theory, Introduction to un-decidability, recursively enumerable sets, primitive recursive functions, recursive set, partial recursive sets, concepts of linear bounded Automata, context sensitive grammars & their equivalence.

List of Referenced Books:

1. Hopcróft & Ullman "Introduction to Automata theory, languages & Computation",NaroshaPublishing house.
2. LewishPapadimutrau "Theory of Computation" , Prentice Hall of India, NewDelhi.
3. Marvin L. Minskay "Computation : Finite & Infinite Machines", PHI.
4. Mishra &ChanderShekhar "Theory of Computer Science (Automate, Language & Computations), PHI.

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C–205: Statistical Computing (Open Elective 1)

Subject Code: C-205	Statistical Computing (Open Elective 1)	L.T.P Model	CREDIT-3

Course Outcomes (CO's): After the completion of this course the students will be able to

CO1: Recall the measures of central tendency (arithmetic mean, median, mode) and their calculation methods. Remember the measures of skewness, moments, and kurtosis and their properties.
CO2: Understand the concepts and calculations of measures of central tendency, skewness, moments, and kurtosis. Grasp the principles and applications of permutations, combinations, and probability laws.
CO3: Apply the formulas and methods to calculate measures of central tendency and skewness. Apply permutation and combination principles to solve problems.
CO4: Analyze the relationships between different measures of central tendency and their graphical representations. Analyze the effects of skewness, moments, and kurtosis on data distributions.
CO5: Evaluate the accuracy and precision of different approximation methods for function regression. Assess the efficiency and reliability of different methods for solving simultaneous linear equations.

Syllabus

Unit I

Measures of central tendency: Arithmetic mean, median and mode, methods of calculating relation between them, properties, graphical representation and problems on application of arithmetic, geometric and harmonic mean.

Skewness, Moments and Kurtosis: Measures of Skewness, Absolute moments, Sheppard's Correction for Moments, Charlier Checks, Pearson's Beta & Gamma Coefficient, Kurtosis.

Unit II

Permutations: Permutations with repetition of objects, circular and restricted permutations

Combinations: Restricted combinations, combinations of objects not all different.

Probability: Additive law of probability, compound events, conditional probability, multiplicative law, multiplication theorem, use of binomial theorem, inverse probability, Bayes theorem, continuous probability.

Unit III

Computes algorithms, computer arithmetic, floating point representation of numbers, floating point arithmetic, errors in numbers and control of errors.

Least square methods of approximation of functions, regression algorithm for linear, polynomial, hyperbolic, trigonometric regression method.

Unit IV

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Solution of simultaneous set of linear equation: Gauss's elimination method, Pivoting , Gausses-Seidal , Gausses Jordan method, To calculate matrix inverse, tri-diagonal set of equations, the Eigen value problem, house holder's method.

Unit V

Interpolation : LaGrange's interpolation, Newton's forward interpolation, back word difference , central difference, Piece-wise linearpolation, Stripling Formulae, Bessel's Formulae.

List of Referenced Books:

1. Numerical Analysis, Shastri, PHI
2. Numerical Analysis, S. Ali Mollah
3. Numerical Analysis, James B. Scarbarough
4. Numerical Methods for Mathematics ,Science &Engg., Mathews, PHI 5.Numerical Analysis,G.S.Rao,New Age International
5. Programmed Statistics (Questions – Answers),G.S.Rao,New Age International
6. Numerical Analysis & Algorithms, Pradeep Niyogi, TMH
7. Computer Oriented Numerical Mathematics, N. Dutta, VIKAS 9.Numerical Methods,Arumugam,Scitech
8. Probability and Statisics for Engineers,Rao,Scitech 11.Numerical Methods in Computer Application,Wayse,EPH

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C-206: Database Management System (DBMS)

Subject Code: C-206	Database Management System (DBMS)	L.T.P Model	CREDIT-3

Course Outcomes (CO's): After the completion of this course the students will be able to

CO1: Recall the fundamental concepts of database management systems (DBMS) and their architecture. Remember the components of data modeling using the Entity-Relationship (E-R) model.
CO2: Understand the differences between a database system and a file system. Grasp the concepts of data modeling, including constraints, keys, and E-R diagrams.
CO3: Apply SQL queries and commands for data manipulation and control. Apply normalization techniques (1NF, 2NF, 3NF, BCNF) to eliminate anomalies in a relational database.
CO4: Analyze the properties of transactions and different types of schedules. Analyze concurrency problems in a database and understand concurrency control protocols.
CO5: Evaluate the effectiveness of different normalization levels in achieving data integrity. Assess the efficiency and correctness of concurrency control protocols.

Syllabus

UNIT I

Introduction- An overview of database management system, DataBase Users, database system Vs file system, Database system concept and architecture, data model schema and instances, Database Structure, data independence and database language and interfaces, Data Modeling using the Entity Relationship Model – Basic Concepts, Constraints, Keys, E-R Diagram, Weak Entity Sets, Extended E-R Features, Design of an E-R Database Schema, Reduction of an E-R Schema to table.

UNIT II

Relational Model- Structure of Relational Database, integrity 8 constraints, entity integrity, referential integrity, Keys constraints, Domain constraints ,The Relational Algebra,The Tuple Relational Calculus, The Domain Relational Calculus; SQL- Concepts of SQL, Importance of SQL, Data Definition Language(DDL),Data Manipulation Language(DML), Data Control Language(DCL), Transactional Control Language(TCL), Aggregate Functions, Joined Relations, View, Trigger.

UNIT III

Relational Database Design: Dependencies in DBMS-Functional, Trasitive, Multivalued, Normalization-Aim of Normalization, Anomolies, Decomposition, First Normal Form(1NF), Second Normal Form(2NF), Third Normal Form(3NF), Boyce-Codd Normal Form(BCNF), Fourth Normal Form(4NF).

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UNIT IV

Trasaction Processing- Key notations in transaction management,Transaction properties, Database Transaction, States of Transactions; Schedule -Serial Schedule, Non-serial Schedule; Serializable schedule,, Conflict and View serializable schedule, Blind Write, Recoverable Schedule; Distributed Database- Distributed trasaction, Concurrency Control in Distributed Database.

UNIT V

Concurrency Problems, Concurrency control, Concurrency Control Protocols(Lock-Based Protocols,2-phase locking Protocols,Timestamp-Based Protocols, validation based protocol. Recovery – Recovery Concepts, Database Recovery Techniques (Log based recovery, Shadow paging), checkpoints, deadlock handling; Database Security concepts. Data Warehouse and Data Mining Concepts.

List of Reference Books:

1. "Database System Concepts" by Korth
2. "Fundamentals of Database Systems" by R Elmasri and S Navathe.
3. "An Introduction to Database Systems" by Bipin Desai.
4. "Database Management Systems" by Raghu Ramakrishnan.
5. "DATA WAREHOUSING, DATA MINING, & OLAP" by Alex Berson, Stephen Smith

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C-207: Project (Summer Training)

Subject Code: C-207	Project (Summer Training)		CREDIT-2

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C-208:Practical based on OOPS Concept & DBMS

Subject Code: C-208	Practical based on OOPS Concept & DBMS	L.T.P Model	CREDIT-3

List of Lab Practicals

1. C++ program to create a simple class and object.
2. C++ | Create an object of a class and access class attributes
3. C++ | Create multiple objects of a class
4. C++ | Create class methods
5. C++ | Define a class method outside the class definition
6. C++ | Assign values to the private data members without using constructor
7. C++ | Create an empty class (a class without data members and member functions)
8. C++ | Create a class with setter and getter methods
9. C++ program to create a class to read and add two distance.
10. C++ program to create a class for student to get and print details of a student.
11. C++ program to create a class for student to get and print details of N students. / C++ program to demonstrate example of array of objects.
12. C++ program to create class to read and add two times.
13. C++ program to create class to read time in seconds and convert into time in (HH:MM:SS) format.
14. C++ program to create class to read time in HH:MM:SS format and display into seconds.
15. C++ program to demonstrate example of friend function with class.
16. Count the created objects using static member function in C++.
17. Create an object of a class inside another class declaration in C++.
18. Example of private member function in C++.
19. Local Class with Example in C++.
20. Structure with private members in C++.
21. Const Member Functions in C++.

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22. Demonstrate Example of public data members in C++.
23. Create a class Point having X and Y Axis with getter and setter functions in C++.
24. Passing an object to a Non-Member function in C++.
25. Accessing Member Function by pointer in C++.
26. Access the address of an object using 'this' pointer in C++.
27. Create a class with public data members only in C++
28. C++ program Input list of candidates and find winner of the Election based on received votes
29. C++ program for Banking Management System using class inheritance

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MCA-III Semester

C-301 Computer Graphics &Image Processing

Subject Code: C-301	Computer Graphics & Image Processing	L.T.P Model	CREDIT-4

Course Outcomes (CO's): After the completion of this course the students will be able to

CO1: Recall the fundamental concepts of database management systems (DBMS) and their architecture. Remember the components of data modeling using the Entity-Relationship (E-R) model.
CO2: Understand the differences between a database system and a file system. Grasp the concepts of data modeling, including constraints, keys, and E-R diagrams.
CO3: Apply SQL queries and commands for data manipulation and control. Apply normalization techniques (1NF, 2NF, 3NF, BCNF) to eliminate anomalies in a relational database.
CO4: Analyze the properties of transactions and different types of schedules. Analyze concurrency problems in a database and understand concurrency control protocols.
CO5: Evaluate the effectiveness of different normalization levels in achieving data integrity. Assess the efficiency and correctness of concurrency control protocols.

Syllabus

UNIT-I

Introduction and Line Generation: Types of computer graphics, Graphic Displays- Random scan displays, Raster scan displays, Frame buffer and video controller, Points and lines, Line drawing algorithms, Circle generating algorithms, Mid-point circle generating algorithm, and parallel version of these algorithms.

UNIT-II

Transformations: Basic transformation, Matrix representations and homogenous coordinates, Composite transformations, Reflections and shearing.

Windowing and Clipping: Viewing pipeline, Viewing transformations, 2-D Clipping algorithms Line clipping algorithms such as Cohen Sutherland line clipping algorithm, clip windows; Polygon clipping – Sutherland Hodgeman polygon clipping.

UNIT-III

Three Dimensional: 3-D Geometric Primitives, 3-D Object representation, 3-D Transformation, 3- D viewing, projections, 3-D Clipping.

Curves and Surfaces: Quadric surfaces, Spheres, Ellipsoid, Blobby objects, introductory concepts of Spline, B-spline and Bezier curves and surfaces.

UNIT-IV

Hidden Lines and Surfaces: Back Face Detection algorithm, Depth buffer method, A- buffer method, Scan line method, basic illumination models, Color consideration, Transparency and Shadows.

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UNIT-V

Digital Image Fundamentals: Steps in Digital Image Processing – Components – Elements of Visual Perception – Image Sensing and Acquisition

Image Enrichment: Spatial Domain: Gray level transformations – Histogram processing – Basics of Spatial Filtering– Smoothing and Sharpening, Color image enhancement.

Image Re-storation : Image Restoration – degradation model, Properties, Noise models

List of Referenced Books

1. Donald Hearn and M Pauline Baker, "Computer Graphics C Version", Pearson Education
2. Foley, Vandam, Feiner, Hughes – "Computer Graphics principle", Pearson Education.
3. Rogers, "Procedural Elements of Computer Graphics", McGraw Hill
4. W. M. Newman, R. F. Sproull – "Principles of Interactive computer Graphics" – Tata MCGrawHill.
5. Amrendra N Sinha and Arun D Udai," Computer Graphics", Tata MCGraw Hill.
6. R.K. Maurya, "Computer Graphics " Wiley Dreamtech Publication.
4. K.C. Kapur, and L.R. Lamberson, "Reliability in Engineering Design", John Wiley, New York.

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C-302: .NET Technology using C#/PHP (Open Elective 2)

Subject Code: C-302	.NET Technology using C#/PHP (Open Elective 2)	L.T.P Model	CREDIT-3

Course Outcomes (CO's): After the completion of this course the students will be able to

CO1: Demonstrate understanding of the .NET framework, C# language, and web development concepts in HTML, DHTML, CSS, JavaScript, PHP, and MySQL.
CO2: Apply C# programming skills to develop console applications, Windows Forms, ASP.NET web forms, and distributed applications.
CO3: Analyze and troubleshoot common issues related to exception handling, multi-threading, networking, and database connectivity in C#.
CO4: Design and implement interactive web interfaces using HTML, CSS, DHTML, and JavaScript to create dynamic and visually appealing web pages.
CO5: Evaluate and utilize PHP and MySQL to develop dynamic web applications with database integration, including data manipulation and retrieval operations.

Syllabus

Unit-I

The .Net framework: Introduction, The Origin of .Net Technology, Common Language Runtime)CLR(, Common Type System)CTS(, Common Language Specification)CLS(, Microsoft Intermediate Language)MSIL(, Just-In –Time Compilation, Framework Base Classes .

C -Sharp Language)C#:(Introduction, Data Types, Identifiers, Variables, Constants, Literals, Array and Strings, Object and Classes, Inheritance and Polymorphism, Operator Overloading, Interfaces, Delegates and Events .Type conversion .

Unit-II

C# Using Libraries: Namespaces, Exception Handling, Multi-Threading, Networking and Socket Programming, Managing Console based I/O Operations, Windows Forms) WPF & WCF(, Asp.net Web Form Controls, and ADO.Net .Distributed Application in C#, Unsafe Mode, Graphical Device interface with C# and Connection with MS- SQL Server.

Unit-III

.Net Assemblies and Attribute. :Net Assemblies features and structure, private and share assemblies, Built-In attribute and custom attribute .Introduction about generic.

Unit -IV

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HTML, DHTML, CSS: Introduction to HTML, HTML fonts Styles, Links, images, Tables ,Static V/S Dynamic Websites ,HTML, attributes, Headings , Paragraphs, Formatting, Lists, Colors, Forms, Links on a same page, Tags DHTML Introduction, Marquee Tag Effects ,CSS Introduction, CSS Id & Class Styling Backgrounds, Fonts, Links, CSS Border Margin, Cell padding.

JAVASCRIPT: JS Introduction, JS client Validations (Null and Password validations) ,JS events.

Unit-V

PHP & MY SQL: PHP installation and Introduction, Loops, String Functions in PHP,PHP Basics, Variables, Arrays in PHP with Attributes, Date & Time, Image Uploading, File handling in PHP, Functions in PHP, Reading data in Web Pages.

MY SQL: Create Database & tables, fields Alter table Insert, Update and where condition Delete, Import and Export Database.

List of Referenced Books:

1 .Wiley, "Beginning Visual C# 2008",Wrox

2 .Fergal Grimes, "Microsoft .Net for Programmers) ."SPI (

3 .Balagurusamy, "Programming with C#",)TMH (

4 .Mark Michaelis, "Essential C# 3.0 :For .NET Framework 3.

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C-303: Python Programming (Open Elective 3)

Subject Code: C-303	Python Programming	L.T.P Model	CREDIT-3

Course Outcomes (CO's): After the completion of this course the students will be able to

CO1: Demonstrate knowledge of Python programming language, including syntax, data types, decision-making statements, loops, functions, strings, lists, tuples, dictionaries, file handling, exceptions, object-oriented programming, and regular expressions.
CO2: Understand the fundamental concepts and principles of Python programming, including data manipulation, file handling, error handling, and object-oriented programming.
CO3: Apply Python programming skills to solve problems, create and manipulate strings, lists, tuples, dictionaries, and files.
CO4: Analyze and evaluate different Python constructs and techniques, including decision-making statements, loops, functions, and object-oriented programming concepts
CO5: Evaluate and assess the efficiency and effectiveness of Python solutions, including code readability, reusability, and error handling.

Syllabus

Unit I

Introduction of python- History, Version, Applications, installation on Windows plateform; Basic Python Syntax-Comments, Triple, Double and Single Quotes, Python back slash, String inside the quotes, Escape Sequence, String Contetination, Formatted output, Intendention; Identifiers, Keywords, Statements and Expressions, Variables, Operators, Precedence and Associativity, Data Types;

Unit II

Decision Making Statements- If Statement, IF..ELIF..ELSE Statement, Nested IF Statement; Loops- while, for, nested loops, break, continue; Functions- Function Definition and Calling the Function, The return Statement and void Function, Scope and Lifetime of Variables, Parameters, Arguments, Command Line Arguments; String - Creating and Storing Strings, Accessing value in string, String Slicing and Joining, String Library, String Methods; Lists- Accessing values in Lists, Updating Lists, Delete Lists Elements.

UNIT III

List Operations, indexing, Slicing, Buit-in Lists Functions and Methods; Tuple - Accessing values in Tuple, Updating Tuple, Delete Tuple Elements, Tuple Operations, indexing, Slicing,

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Buit-in Tuple Functions and Methods; Dictionory - Accessing values in Dictionory, Updating Dictionory, Delete Dictionory Elements, Buit-in Functions and Methods.

UNIT IV

File Handling and Exceptions- Reading text from a file, Writing text to a file, Pickling, Unpickling, Try and Except clause. Object – Oriented Programming Overview- instace variables, the __init_method, Class Variables, Class inheritance, Overrriding methods, Operator overloading, The class method, The static method. Regular Expression- match search function, search and replace, regular expresssion modifiers, regular expression patterns.

UNIT V

Introduction of Data Science with python - Data Science Overview, Python Environment Setup and Essentials, Anaconda, Mathematical Computing with Python (NumPy), Scientific computing with Python (Scipy), Data Manipulation with Pandas,Data Visualization in Python using matplotlib,Machine Learning with Scikit–Learn, Introduction to the Python Deep Learning Library TensorFlow.

List of Reference books:

1. John M. Sewart, "Python for Scientist", Cambridge Universities Press.

2. Reema Thareja, "Python Programming" Oxford Higher Education.

3. Robert Sedgewick, Kevin Wayne, Robert Dondero, "Introduction to Programming in Python" Pearson

5. "Python 3 Standard Library By Example 2017" Edition by Doug Hellmann. PEARSON INDIA.

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C-304 Data Warehousing & Data Mining

Subject Code:C-304	**Data Warehousing & Data Mining**	L.T.P Model	CREDIT-3

Course Outcomes (CO's): After the completion of this course the students will be able to

CO1: Demonstrate understanding of the fundamentals of data warehousing, data mining systems, data preprocessing, data mining primitives, and data mining query languages.
CO2: Explain the concepts and principles of data warehousing, including multidimensional database structures, data integration and transformation, online data storage, and metadata..
CO3: Apply data preprocessing techniques to clean, integrate, transform, and reduce data for data mining purposes
CO4: Analyze and evaluate different data mining algorithms and methods, such as association rule mining, classification, prediction, and clustering.
CO5: Evaluate the accuracy and effectiveness of data mining models and techniques, considering factors such as classifier accuracy, data quality, and clustering methods.

Syllabus

UNIT-I

Introduction: Fundamentals of data warehousing, Data mark, Concept of Data ware housing, multi-dimensional database structure, client-server model, component of data ware housing, building Data ware house, Functionalities, Classification of Data Mining systems, Major issues in Data Mining, Data Warehouse and OLAP Technology for Data Mining Data Warehouse, Multidimensional Data Model, Data Warehouse Architecture.

UNIT-II

Data Preprocessing: Needs Preprocessing the Data, Data Cleaning, Data Integration and Transformation, Data Reduction, Discretization and Concept Hierarchy Generation, Online Data Storage, mapping data ware house schema, Meta data, dimension table and fact table.

UNIT-III

Data Mining Primitives, Languages, and System Architectures: Data Mining Primitives, Data Mining Query Languages, Designing Graphical User Interfaces Based on a Data Mining Query Language Architectures of Data Mining Systems,

UNIT-IV

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Mining Association Rules in Large Databases: Association Rule Mining, Mining Single-Dimensional Boolean Association Rules from Transactional Databases, Mining Multilevel Association Rules from Transaction Databases, Mining Multidimensional Association Rules from Relational Databases and Data Warehouses, From Association Mining to Correlation Analysis, Constraint-Based Association Mining.

UNIT-V

Classification and Prediction: Issues Regarding Classification and Prediction, Classification by Decision Tree Induction, Bayesian Classification, Classification by Back propagation, Classification Based on Concepts from Association Rule Mining, Other Classification Methods, Prediction, Classifier Accuracy, Data in Cluster Analysis, A Categorization of Major Clustering Methods, Partitioning Methods.

List of Reference Books:

1. Data Warehousing in the Real World – SAM ANAHORY & DENNIS MURRAY.PearsonAsia.
2. Data Mining Techniques – ARUN K PUJARI, University Press Building the DataWarehouse- W. H. Inmon, Wiley Dreamtech India Pvt. Ltd..

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C-305 Design and Analysis of Algorithm

Subject Code: C-305	C-305 Design and Analysis of Algorithm	L.T.P Model	CREDIT-3

Course Outcomes (CO's): After the completion of this course the students will be able to

CO1: Demonstrate knowledge of various data structures, algorithms, and asymptotic notations used in algorithm analysis and design.
CO2: Understand the concepts and principles of greedy methods, dynamic programming, advanced data structures, and NP completeness.
CO3: Apply data structures and algorithms to solve problems, including knapsack problems, spanning trees, optimal storage, matrix multiplications, and binary search trees.
CO4: Analyze and evaluate the efficiency and complexity of algorithms using asymptotic behavior, time and space complexity, and worst-case analysis.
CO5: Evaluate the complexity and feasibility of problems and algorithms in terms of NP completeness, polynomial time, and verification.

Syllabus

Unit I

Review of data review of data structures, linked list, stack, queue, tree, binary tree and graph, Divide & Conquere methods, binary search and its time-complexity, Quick sort, Merge sort, Heap sort, analysis of algorithms, asymptotic behavior of algorithm, asymptotic notations(Big O, Big omaga and Big Theta Notations) time ans space complexity of algorithms, average and worse case analysis of algorithms, Finding asymptotic Complexities.

Unit II

Greedy Method: General method, Knapsack problems, Spanning trees, prime's algorithms, Kruskal algorithms, Dijk Stra algorithms, Optimal storage on tapes, Huffman Codes.

Unit III

Dynamic programming, general methods, matrix multiplications, Single source shoetest path algoritms, Dijk Stra's algorithms, Basic search and traversal techniques, Techniques for binary tree, Depth first search, Breath first search, Adjecancy matrix, and link list representation of graphs, Bi-connected Components.

Unit IV

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Advance data structure, Binary search tree, Red- Black tree, insertion, delition in binary search tree, B-tree, Basic operation on B- tree, Binomial Heaps, Binomianl trees.

Unit V

NP Completeness: Basic concepts, polinomial time, abstract problems, Encoding, Formal languages, polinomial time verification, The time complexity class, P, NP and NP Completeness, permeability,
Hermite domain cycle.

List of Reference Books:

(i) Analysis and Desisn of Algorithms by Horowitz Sahani, PHI publication
(ii) Analysis and design of algorithms by Schaum's

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C-306 Optimization Techniques

Subject Code:C-306	Optimization Techniques	L.T.P Model	CREDIT-3

Course Outcomes (CO's): After the completion of this course the students will be able to

CO1: Demonstrate knowledge of various data structures, algorithms, and asymptotic notations used in algorithm analysis and design.
CO2: Understand the concepts and principles of greedy methods, dynamic programming, advanced data structures, and NP completeness.
CO3: Apply data structures and algorithms to solve problems, including knapsack problems, spanning trees, optimal storage, matrix multiplications, and binary search trees.
CO4: Analyze and evaluate the efficiency and complexity of algorithms using asymptotic behavior, time and space complexity, and worst-case analysis.
CO5: Evaluate the complexity and feasibility of problems and algorithms in terms of NP completeness, polynomial time, and verification.

Syllabus

Unit I
Introduction of Optimization Techniques, Linear Programming, Mathematical Formulation, Graphical Methods for two dimensional problems.Simplex Method,Big-M Method & Two Phase Methods, Assignment Problem, Transportation Problem, Sequencing Problem & its Solution's.

Unit II
Integer Programming-Cutting Plane, Branch & Bound Methods
Game Theory-Two person Zero Sum game, saddle point determination, algebraic method, graphical method etc.

Unit III
Replacement Problem: Replacement theory of items, the deteriorate- replacement of items that fail. Group and Individual replacement.

Unit IV

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Inventory Control- Determination of EOQ, Components, Deterministic Continuous & Deterministic Periodic Review Models, Stochastic Continuous & Stochastic Periodic Review Models.

Unit V

Optimization Models- The shortest path problem, Minimum Spanning Tree Algorithm, Maximal Flow Algorithms, PERT/ CPM.

List of Referenced Books:

1. Operation Research, KantiSwaroop
2. Operation Research,V.K. Kapoor
3. Operation Research,PaneerSelvam,PHI
4. Operations Research, Hillier & Lieberman, TMH

C-307 Mini Project

Subject Code:C-307	**Mini Project**		CREDIT-2

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C-308 Practical

Subject Code:C-308	C-308 Practical	L.T.P Model	CREDIT-4

List of Lab practicals

1. Program to Draw a Line using DDA Algorithm
2. Program to Draw a Line using Bresenhams Algorithm
3. Program to draw a line using Cartesian Slope-Intercept Equation
4. Program to Draw a Circle using Mid-Point Algorithm
5. Program to Draw a Circle using Bresenham's Algorithm
6. Program to Draw Circle (Simple Program)
7. Program to draw a Circle having Changing its Color and Design
8. Program to draw a Circle using Direct Algorithm
9. Program to draw an Ellipse using Mid-Point Ellipse Algorithm
10. Program to draw an Ellipse with Different Colors
11. Program to draw Polar Ellipse
12. Program to draw an Ellipse Showing Two Axis
13. Program to plot Bezier curve in C.
14. Program to plot B spline curve in C.
15. Program to shift an object,
16. Program to rotate an object.
17. Program to reflect an object.
18. Program to scale up and scale down an object.
19. Program to get the projection of an object.
20. Program to create blobby objects.

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MCA IV Semester

C- 401 Soft Computing

Subject Code:C-401	**Soft Computing**	L.T.P Model	CREDIT-3

Course Outcomes (CO's): After the completion of this course the students will be able to

CO1: Demonstrate knowledge of basic concepts and models of artificial neural networks, learning processes, signal layer perceptrons, fuzzy set theory, and genetic algorithms.
CO2: Understand the characteristics, architectures, and learning tasks associated with neural networks, as well as the principles and algorithms of signal layer perceptrons, fuzzy logic, and genetic algorithms.
CO3: Apply neural network models, learning algorithms, and optimization techniques to solve problems in adaptive filtering, feature detection, and fuzzy systems.
CO4: Analyze the convergence, performance, and decision-making capabilities of multi-layer perceptrons, fuzzy rule-based systems, and genetic algorithms.
CO5: Evaluate the effectiveness and efficiency of neural network models, fuzzy systems, and genetic algorithms in solving complex problems, considering convergence, mutation rates, and decision-making accuracy.

C-401 Soft Computing

Syllabus

Unit-1

Neural Network: Basic Concepts of Neural Network, Models of artificial Neural Network, Characteristics of Neural Networks Network Architectures, Artificial intelligence and Neural Networks Learning Processes: Introduction, Error-Correction Learning, Memory-Based Learning, Memory-Based learning, Hebbian Learning. Competitive Learning, Boltzmann Learning, Credit Assignment Problem, Learning with a Teacher, Leaning Tasks, Statistical Nature of the Learning Process, Statistical Learning Theory, Probably Approximately Correct Model of Learning.

Unit-II

Singal Layer Perceptrons: Adaptive Filtering Problem, Unconstrained Uptimization techniques, Linear Least Squares Filters, Learning Curves, Learning Rate Annealing Techniques, Perceptron, Perceptron Convergence Theorem Multi Layer Perceptrons: Some Preliminiaries, Back-Propagation Algorithm, Summary of the Back- Propagation Algorithm, XOR Problem, Heuristics for Making the Back-Propagation Algorithm Perform Better,

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Output Representation and Decision Rule, Computer Experiment, Feature Detection, Back-Propagation and Differentiation

Unit-III

Fuzzy Logic: Fuzzy Set Theory: Fuzzy Verses crisp, Crisp Sets, Fuzzy Sets, Crisp Relations, Fuzzy Systems: Crisp Logic, Predicate Logic, Fuzzy Logic, Fuzzy rule based system, De Fuzzification Systems,

Unit-IV

Genetic Algorithms: Fundamental of Genetic algorithm, Genetic algorithms, basic concept of genetic algorithm, creation of rings, working principal, encoding, fitness function, reproduction.

Unit-V

Inheritance operators, cross over, inversion and deletion, mutation operation, Genetic Modeling: bitwise operators, bitwise operators used in genetic algorithm, generational cycle, convergence of genetic algorithm.

Test Books and References:

1. Neural Network, Fuzzy Logic and genetic algorithm by S. Rajshekharan, G.A. Vijaylaxmi Pal, Publication PHI
2. Introduction to neural network By ANDERSON, JAMES A. Publication PHI
3. Introduction to genetic algorithm by Melanie Mitchell
4. Genetic algorithm by Goldberg

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C-402 Compiler Design

Subject Code:C-402	**Compiler Design**	L.T.P Model	CREDIT-3

Course Outcomes (CO's): After the completion of this course the students will be able to

CO1: Demonstrate knowledge of the structure of compilers, lexical analysis, syntax analysis, and the role of lexical analysis in the compilation process.
CO2: Understand the principles and techniques of parsing, including shift-reduce parsing, predictive parsing, and L-R parsing. Comprehend the concept of symbol tables and their role in compiler design.
CO3: Apply lexical analysis and parsing techniques to implement a compiler, perform optimization, and generate efficient object code.
CO4: Analyze the principles and sources of optimization, including loop optimization and code optimization. Analyze the flow graph and determine loop invariants for optimization.
CO5: Evaluate the effectiveness of code optimization techniques, object program generation, and register allocation strategies. Assess the challenges and potential problems in code generation.

Syllabus

Unit I

Compiler & translator, Structure of Compiler, Lexical analysis, Syntax analysis, Bootstrapping, Cross Compiler, Unicity Tools

Unit II

The role of Lexical analysis, regular information, finite automata, Implementation to a lexical analysis, Context free Grammar, Derivation tree and Parse tree

Unit III

Parser, Shift reduce parsing, Predictive parsing, L-R parsing, Symbol table, Context and Data Symbol table

Unit IV

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Principle of sources of optimization, Loop optimization, DAG, Base Block, Determination, Reducible flow graph, Loop in variant computation.

Unit V

Code optimization, principles of optimization, source of optimization, DAG, DAG representation of basic block, domain reducible flow graph, Code optimization, Object program, Problems in code generation, machine Model, Register allocation and Assignment.

List of Reference Books:

(i) Principle of Compiler Design by Aho and Ullman PHI publication

(ii) Compiler Design by Aho, Ullmann &n Sethi PHI Publication

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C-403 Network Security (Open Elective 4)

Subject Code: C-403	**Network Security**	L.T.P Model	CREDIT-3

Course Outcomes (CO's): After the completion of this course the students will be able to

CO1: Demonstrate knowledge of network security concepts, including confidentiality, data integrity, authentication, and non-repudiation. Understand classical encryption techniques and their cryptanalysis.
CO2: Understand modern encryption techniques, such as Simplified DES, DES, Triple DES, and IDEA. Comprehend the security issues associated with these methods.
CO3: Apply conventional encryption techniques for achieving confidentiality, including encryption placement, traffic confidentiality, key distribution, and random number generation.
CO4: Analyze the principles of public key cryptography, specifically the RSA algorithm. Analyze message authentication, hash functions, and MAC algorithms. Evaluate the security and authentication protocols.
CO5: Evaluate the effectiveness of various security measures and protocols in ensuring network security. Assess the vulnerabilities and risks associated with different security systems.

Syllabus

Unit I

Network Security Introduction:Confidentiality, Data Integrity, Authentication, Non-Repudiation, Overview of Issues involved, Classical Encryption Techniques: Mono alphabetic, Substitution Methods, Poly alphabetic Substation Methods, Permutation Methods, Cryptanalysis of these Methods.

Unit II

Modern Encryption Techniques: Simplified DES, DES, Triple DES, Block Cipher, Design Principles, Block Cipher Modes of Operation. IDEA Security Issues Involved with these methods.

Unit III

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Confidentiality Using Conventional Encryption: Placement of Encryption, Traffic Confidentiality, Key Distribution, RandomNumber, Generation.

Unit IV

Introduction to Number Theory: (Basics Pertaining to Security Related Algorithms). 6. Public Key Cryptography: Principles -- RSA Algorithm. Message Authentication and Hash Functions, Hash an MAC Algorithms. Digi Signatures and Authentication Protocols, Authentication Applications.

Unit V

Overview of Electronic Mail Security, IP Security, WEB Security, System Security: Intruders, Viruses and Worms, Firewalls, Kerberos.

List of Referenced Book:

1. Cryptography and Network Security, William Stallings. (Second Edition) Pearson Education Asia
2. Network Security: The Complete Reference by Roberta Bragg, Mark Phodes-Ousley, Keith Strassberg Tata Mcgraw-Hill
3. Handbook of Applied Cryptography

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C-404 Mobile Computing

Subject Code:C-404	**Mobile Computing**	L.T.P Model	CREDIT-3

(CO's): After the completion of this course the students will be able to

CO1: Understand the fundamental concepts of mobile computing, including issues, wireless telephony, cellular concepts, GSM, CDMA, and GPRS..
CO2: Grasp the principles of wireless networking, including wireless LAN, multiple access protocols, TCP over wireless, Mobile IP, and WAP architecture.
CO3: Apply data management techniques in mobile computing, including data replication, adaptive clustering, file systems, and disconnected operations.
CO4: Analyze the concepts of mobile agent computing, security, fault tolerance, and transaction processing in a mobile computing environment.
CO5: Evaluate the effectiveness of different techniques and protocols in mobile computing, considering their advantages, limitations, and applicability in various scenarios.

Syllabus

Unit - I

Introduction, issues in mobile computing, overview of wireless telephony: cellular concept, GSM: air-interface, channel structure, location management: HLR-VLR, hierarchical, handoffs, channel allocation in cellular systems, CDMA, GPRS.

Unit - II

Wireless Networking, Wireless LAN Overview: MAC issues, IEEE 802.11, Blue Tooth, Wireless multiple access protocols, TCP over wireless, Wireless applications, data broadcasting, Mobile IP, WAP: Architecture, protocol stack, application environment, applications.

Unit – III

Data management issues, data replication for mobile computers, adaptive clustering for mobile wireless networks, file system, disconnected operations.

Unit - IV

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Mobile Agents computing, security and fault tolerance, transaction processing in mobile computing environment.

Unit – V

Adhoc networks, localization, MAC issues, Routing protocols, global state routing (GSR), Destination sequenced distance vector routing (DSDV), Dynamic source routing (DSR), Ad Hoc on demand distance vector routing (AODV), Temporary ordered routing algorithm (TORA), QoS in Ad Hoc Networks, applications.

Text Books:

1. J. Schiller, "Mobile Communications", Addison Wesley.
2. Charles Perkins, "Mobile IP", Addison Wesley.
3. Charles Perkins, "Ad hoc Networks", Addison Wesley.
4. Upadhyaya, "Mobile Computing", Springer New York.

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C-405 Advanced Computing Techniques (Open Elective 5)

Subject Code:C-405	**Advanced Computing Techniques**	L.T.P Model	CREDIT-3

Course Outcomes (CO's): After the completion of this course the students will be able to

CO1: Understand the theoretical basis of quantum computing, including qubits, quantum entanglement, density matrix, and maximally entangled states (MES).
CO2: Grasp the concepts and architecture of cloud computing, including service models (IaaS, PaaS, SaaS), deployment models (public, private, hybrid, community), and the role of open standards.
CO3: Apply the principles of the Internet of Things (IoT) by understanding sensing, actuation, networking basics, communication protocols, IoT architecture, and the physical and logical design of IoT systems.
CO4: Analyze big data analytics, including the challenges of conventional systems, the importance of big data, technologies for handling big data, and the applications of big data analytics.
CO5: Evaluate the advantages and limitations of quantum computing, cloud computing, IoT, big data analytics, and machine learning in various contexts, considering their potential impact and ethical considerations..

Syllabus

UNIT I

Quantum Computing- Theoretical Basis of Quantum Computing; Coherent state, q-bits, 2-qubits and 3–qubits System. Quantum Entanglement, Hamming Spaces, Maximally Entangled States (MES), Density Matrix, Bell's MES.

UNIT II:

Cloud Computing - Introduction to Cloud Computing, History of Cloud Computing, Cloud service providers, Pros and Cons of Cloud Computing, Role of Open Standards,Cloud Computing Architecture, Introduction of Service Models (XaaS), Infrastructure as a Service(IaaS),Platform as a Service(PaaS), Software as a Service(SaaS).Deployment Models: Public cloud,Private cloud, Hybrid cloud,Community cloud.

UNIT III:

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Internet of Things(IoT): Introduction to Internet of Things(IoT), Sensing, Actuation, Networking basics, Communication Protocols, Sensor Networks, Machine-to-Machine Communications, IoT Definition, Characteristics. IoT Functional Blocks, Physical design of IoT, Logical design of IoT, Communication models & APIs. IoT Architecture.

UNIT IV:

Big Data analytics: Overview of Big Data, Big Data in Businesses, Challenges of Conventional Systems, Big Data and its importance, Big data analytics, Big data applications, Technologies for Handling Big Data, Understanding Hadoop Ecosystem.

UNIT V:

Machine Learning: Introduction and Basic Concepts of Machine Learning, Applications of ML, Taxonomy of Machine Learning: Supervised, Unsupervised, Reinforcement learning, Linear Vs Non Linear, Regression vs. Classification, Bias-variance trade-off, Overfitting, Under fitting, Decision trees, Gradient descent, Support Vector Machine (SVM), ML algorithms: Logistic regression, Naïve Bayes, K-Nearest Neighbors, K mean Clustering.

List of Reference Books:

1. Quantum Computing, Quantum Mechanics By Prof. B. S. Rajput
2. Rittinghouse, John W., and James F. Ransome, —Cloud Computing: Implementation, Management and Security, CRC Press, 2017.
3. Raj KumarBuyya, Christian Vecchiola, S. ThamaraiSelvi, —Mastering Cloud Computing, Tata Mcgraw Hill, 2013.
4. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, StamatisKarnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1st Edition, Academic Press, 2014.
5. Peter Waher, "Learning Internet of Things", PACKT publishing, BIRMINGHAM – MUMBAI

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C-406 Practical

Subject Code:C-406	**Practical**	L.T.P Model	CREDIT-4

List of Lab Practicals

1. To perform Union, Intersection and Complement operations.
2. To implement De-Morgan's Law.
3. To plot various membership functions.
4. To implement FIS Editor. Use Fuzzy toolbox to model tip value that is given after a dinner based on quality and service.
5. To implement FIS Editor.
6. Generate ANDNOT function using McCulloch-Pitts neural net.
7. Generate XOR function using McCulloch-Pitts neural net.
8. Hebb Net to classify two dimensional input patterns in bipolar with given targets.
9. Perceptron net for an AND function with bipolar inputs and targets.
10. To calculate the weights for given patterns using hetero-associative neural net.
11. To store vector in an auto-associative net-Find weight matrix & test the net with input
12. To store the vector, find the weight matrix with no self-connection. Test this using a discrete Hopfield net.

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C-407 Project

Subject Code:C-407	**Project**	L.T.P Model	CREDIT-6

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Detailed Syllabus for Elective Papers:

Java & PHP (Open Elective 7)

Open Elective 7	Java & PHP	L.T.P Model	CREDIT-4

Course Outcomes (CO's): After the completion of this course the students will be able to

CO1: Acquire knowledge of Java programming language, including its syntax, data types, control statements, object-oriented concepts, exception handling, multithreading, I/O operations, networking, and event handling.
CO2: Understand the concepts of applets, AWT controls, Swing applications, Java Beans, Enterprise Java Beans (EJB), RMI (Remote Method Invocation), servlets, and JSP (JavaServer Pages).
CO3: Apply the concepts of HTML and CSS to create static and dynamic websites, including formatting text, working with links, images, tables, forms, and applying CSS styles.
CO4: Analyze and manipulate data using PHP, including variables, arrays, loops, string functions, date and time, image uploading, file handling, and web page data reading. Understand the basics of MySQL database, including creating tables, performing CRUD operations, and importing/exporting data.
CO5: Evaluate the efficiency and effectiveness of different programming concepts and technologies in web development, considering factors such as performance, security, scalability, and usability.

Unit-1

Java: Introduction, Concept of JVM, JRE & JDK, Operator, Data type, Variable, Arrays, Control Statements, Methods & Classes, Inheritance,Package and Interface, Exception Handling, Multithread programming, I/O,String handling, Networking, Event handling, Layout managers, images.

Unit-2

Introduction of Applet and Applications, Introduction of AWT &AWT controls,Labels, Textfields, Buttons,Checkboxes, Radio Buttons, Scroll Bars, Lists, Combo box, Progress Bar, Menus and Toolbars, JDBC: The connectivity Model, JDBC/ODBC Bridge. Sql Connectivity with database.Introduction of Swing Applications.

Unit-3

Java Beans: Application Builder tools, The bean developer kit(BDK), JAR files, Introspection, Developing a simple bean,using Bound properties, The Java Beans API, Session Beans, Entity Beans, Introduction to Enterprise Java beans (EJB),

RMI: Introduction to RMI (Remote Method Invocation): A simple client-server application using RMI. Introduction of Servlet, Introduction & JSP.

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Unit- 4

HTML, CSS: Introduction to HTML, HTML fonts Styles, Links, images, Tables ,Static V/S Dynamic Websites ,HTML, attributes, Headings , Paragraphs, Formatting, Lists, Colors, Forms, Links on a same page, Tags

CSS:CSS Introduction, CSS Id & Class Styling Backgrounds, Fonts, Links, CSS Border Margin, Cell padding.

JAVASCRIPT: JS Introduction, JS client Validations (Null and Password validations), JS events.

XML– Introduction-Form Navigation-XML Documents- XSL – XSLT- Web services-UDDI-WSDL-java web services – Web resources.

Unit-5

PHP & MY SQL:PHP installation and Introduction, Loops, String Functions in PHP,PHP Basics, Variables, Arrays in PHP with Attributes, Date & Time, Image Uploading, File handling in PHP, Functions in PHP, Reading data in Web Pages.

MY SQL: Create Database & tables, fields Alter table Insert, Update and where condition Delete, Import and Export Database.

List of Reference Books:

1. Margaret Levine Young, "The Complete Reference", Tata McGraw-Hill Education Pvt. Ltd.
2. Thampi, "Object Oriented Programming in JAVA" Wiley Dreamtech Publication.
3. Balagurusamy E, "Programming in JAVA", Tata McGraw-Hill Education Pvt. Ltd.
4. Dustin R. Callway, "Inside Servlets", Addison Wesley.

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Parallel Processing (Open Elective 6)

Open Elective 6	Parallel Processing	L.T.P Model	CREDIT-4

Course Outcomes (CO's): After the completion of this course the students will be able to

CO1: Acquire knowledge about parallel computing, including the basic concepts, levels of parallel processing, dataflow computing, and classification of parallel computers based on various criteria.
CO2: Understand the interconnection network in parallel computing, including its importance, bandwidth, nodal degree, diameter, bisection bandwidth, and different types of static and dynamic interconnection networks.
CO3: Apply the principles of parallel computer architecture, including pipeline processing, vector/array processing, VLIW and superscalar architectures, associative architectures, and multi-threaded architectures.
CO4: Analyze and evaluate the performance and efficiency of parallel algorithms, including their design, analysis, and implementation in different models of computation. Understand the concepts of combinational circuits, permutation circuits, sorting circuits, and matrix computations.
CO5: Evaluate the suitability and effectiveness of different parallel computing models, architectures, and interconnection networks for specific computational tasks, considering factors such as scalability, speedup, and communication overhead.

Unit 1

Introduction to Parallel Computing, Basic concepts about program/process/ thread concurrent Execution Parallel Execution, granularity, Potential of Parallelism, Need of Parallel Computation, Levels of parallel processing Parallel processing Vs. Parallel computing, Dataflow Computing concepts.

Unit 2

Classification of Parallel Computers, Types of Classification, Flynn's/ Handler classification, UMA / NUMA /COMA, Loosely coupled / tightly couple, Classification based grain size and Instruction level parallelism

Unit 3

Interconnection Network, Need of Interconnection Network, Concept Bandwidth Nod degree diameter bisection bandwidth, In degree and Out degree , Static and Dynamic

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Interconnection network, Omega, Parallel Shifter, Bens, permutation, hypercube, butterfly, Shuffle exchange Network

Unit 4

Parallel Computer Architecture, Introduction to various computer architecture, Pipeline processing, Vector / Array, processing, VLIW and Super scalar architecture, Associative architecture, Multi-threaded, architecture

Unit 5

Parallel Algorithm, Introduction to Parallel Algorithm, Analysis of Parallel Algorithms, Different models of computation, Combinational circuit, Permutation Circuit, Sorting circuit, Matrixcomputation.

List of Referenced Books:

1. Programming Massively Processors : David Kirk third edition
2. Applied Parallel Computing :Yefaun Deng
3. Parallel Computing : Wang's& Briggs

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CLOUD COMPUTING (Open Elective 8)

Open Elective 6	**Cloud Computing**	L.T.P Model	CREDIT-4

Course Outcomes (CO's): After the completion of this course the students will be able to

CO1: Acquire knowledge about cloud computing, including its definition, benefits, usage scenarios, major players, and issues associated with cloud environments. Understand different types of clouds and cloud architectures.
CO2: Understand the various types of cloud services, such as Software as a Service (SaaS), Platform as a Service (PaaS), Infrastructure as a Service (IaaS), and their applications. Comprehend the role of major cloud service providers and their offerings.
CO3: Apply cloud services for collaboration purposes, including email communication, CRM management, project management, event management, task management, word processing, presentation creation, spreadsheet handling, databases, and social networks.
CO4: Analyze the need for virtualization in cloud computing, understand the pros and cons of virtualization, and differentiate between different types of virtualization technologies and hypervisors. Evaluate the properties and capabilities of virtual machines.
CO5: Evaluate the suitability and effectiveness of different cloud service providers, architectures, and standards for specific business requirements. Assess the advantages and challenges associated with cloud computing, and propose solutions to address potential issues.

UNIT I

Introduction: Cloud-definition, benefits, usage scenarios, History of Cloud Computing - Cloud Architecture - Types of Clouds - Business models around Clouds – Major Players in Cloud Computing- issues in Clouds - Eucalyptus - Nimbus - Open Nebula, Cloud Sim.

UNIT II

Cloud Services: Types of Cloud services: Software as a Service-Platform as a Service – Infrastructure as a Service - Database as a Service - Monitoring as a Service –Communication as services. Service providers- Google, Amazon, Microsoft Azure, IBM, Sales force.

UNIT III

Collaborating Using Cloud Services: Email Communication over the Cloud - CRM Management - Project Management-Event Management - Task Management – Calendar - Schedules - Word Processing – Presentation – Spreadsheet - Databases – Desktop - Social Networks and Groupware.

UNIT IV

Virtualization For Cloud: Need for Virtualization – Pros and cons of Virtualization – Types of Virtualization –System VM, Process VM, Virtual Machine monitor – Virtual machine

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properties - Interpretation and binary translation, HLL VM - Hypervisors – Xen, KVM , VMWare, Virtual Box, Hyper-V.

UNIT V

Security, Standards and Applications: Security in Clouds: Cloud security challenges – Software as a Service Security, Common Standards: The Open Cloud Consortium – The Distributed management Task Force – Standards for application Developers – Standards for Messaging – Standards for Security, End user access to cloud computing, Mobile Internet devices and the cloud.

TEXT BOOKS:

1. John Rittinghouse& James Ransome, Cloud Computing, Implementation, Management and Strategy, CRC Press, 2010.

2. Michael Miller, Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Que Publishing, August 2008.

3. James E Smith, Ravi Nair, Virtual Machines, Morgan Kaufmann Publishers, 2006.

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Programme, Programme Specific and Course Outcomes

(PO, PSO & CO)

Post Graduate Diploma in Computer Applications(PGDCA)

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Post Graduate Diploma in Computer Applications (PGDCA)	
PO-1	Make use of internet for searching and downloading information on web, sending or receive e-mails
PO-2	Prepare presentation and perform computation on Tools Like Power Point
PO-3	Handle windows and Linux operating system for general-purpose applications and networking.
PO-4	Develop general-purpose application based on C/C++ and HTML based languages.
PO-5	Perform various office activities on computer system such as installation of software, handling of printer and scanner, internet connection along with troubleshooting of system.

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PGDCA **Programme Specific Outcomes (PSOs)**	
PSO-1	Encourage the students to acquire real awareness to computer applications
PSO-2	To encourage students to develop the skill of formulation of real-life problems into the form of Computer based problems and find solutions using different algorithms
PSO -3	To learn the organization and Installation of Software and Hardware

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Course outcomes (CO's)-After the completion of these course students will be able to do following:

C-101 Computer Organization

CO1 : To understand the concept of Computer and its Components

CO2 : To Apply the concept of Boolean Logic and learn the operations of Gates.

CO3 : To Synthesize the various number system and their conversion.

CO4 : To evaluate the binary representations

CO5 : To Explore the Application of Computers

C-101 Computer Organization:

Unit I:

Number System: Binary, Octal, Hexadecimal and Computer Arithmetic with them. Addition and Subtraction for sign machine and 2's complement numbers. Floating-point representation and arithmetic. Computer codes binary, ASCII, EBCIDC, Redundant and error correcting codes.

Introduction to the computer as a purposeful collection of inter-linked elements CPU, Memory and I/O units.

Unit II:

Structure and function of CPU as a collection of Registers, Arithmetic Logic and Control Unit. Concept of Storage, fetch and execution of instructions via data control and address buses. Types of main and auxiliary memory, RAM, ROM, PROM, DISK and TAPE memories. Static and Dynamic RAM.

Unit III:

Logic Design of Computer, Truth Table, Boolean Algebra, AND, OR, NAND, NOR gates, Multiplexes, Flip-Flops shift registers and counters, decoders, encoders, design of combinational circuits, Speed mismatch between CPU and peripherals.

Unit IV:

Flow of information among CPU, Memory and peripherals. Handling of interrupt, Programmed and DMA transfer of data, I/O buffers, handshaking, Design of I/O channels, Virtual memory, Time Sharing, Multiprogramming systems.

Reference:

Computer System Architecture By Moriss Mano

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C-102 Programming in C & Data Structure

CO1 : To understand the concept of Computer Programming & Algorithms

CO2 : To Apply the concept of Flow Chart and Logic

CO3 : To Learn the various Programs based on looping and branching.

CO4 : To evaluate the usage of data types

CO5 : To Explore the Application of Computers Programs

Unit I:

Overview of programming: Introduction to computer based problems solving. Program design and implementation issues. Programming environment.

Unit II:

Fundamental of C Programming: Overview of C. Data Types. Operators. Expression. Control Constructs. Arrays. Basic I/O. Program Design examples. Advanced features.

Unit III:

Advanced Programming Techniques: Control Constructs. Functions and Recursion.

Unit IV:

Introduction to Pointers. Structures. Union. File Handling: File Pointers. File Accessing functions. Slandered C Header and Library Files. Command Line Argument. Creating Project Files.

Unit V:

Basic Concepts of data representation. Introduction to algorithm design and data structure. representation of arrays. single & multidimensional arrays. its storage. Stacks and Queues: Representation of stacks and queues. circular queues. application of stacks. introduction to postfix. priority queues. Link List : Singly linked list. operation on the list circular list. Double linked list. Simulation using linked lists. garbage collection.

Reference:

Programming in C by Raja Raman.
Data Structures Using C and C++ by Tenanbaum
Data Structures Using C by Schaum Series.

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C-103 PC SOFTWARE SKILLS

CO1 : To understand the concept of Software and its categories

CO2 : To Apply the concept of system and application software.

CO3 : To Synthesize the software with its applications.

CO4 : To evaluate the software applications

CO5 : To Explore and learn installation of software

Unit I:
History of computer and generations of computers, Classification, Hardware, Software, Representation of information, types of software: System and application software.

Unit II:
Windows: Windows basic, Explorer, Internet Explorer, File Management Device Management, OLE Concepts.

Unit III:
Word processor: Basics of word processing, Document Enhancement. Graphics using templates and wizards.
Spreadsheet: Worksheet basics, Formatting and Calculation. Functions and macros, working with graphs and charts, Multiple worksheets.
Presentation Tools: (MS-Power Point): Presentation of slides, Movements of Slides, etc.

Unit IV:
Internet Fundamentals: Surfing and usage of internet, Email, FTP, TELNET, WWW, etc.

Unit V:
Hypertext Mark Up Language and Dynamic Hypertext Mark Up Language, HTML/DHTML & Designing Tools.

Reference:

Microsoft Office: Reference book published by TMH

HTML: Reference book published by BPB.

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C-104 System Analysis & Design

CO1 : To understand the concept of System, CBIS, MIS and its categories

CO2 : To Apply the concept of system with its SDLC.

CO3 : To Synthesize the system Cot Benefits Analysis.

CO4 : To evaluate the System Development Cost with COCOMO

CO5 : To Explore and learn installation of New System

Unit I:
Introduction to system definition and concepts: Real Life business sub system, System Environment and Boundaries, Role and need of System Analysis, Introduction of SDLC (System Development Life Cycle).

Unit II:
System Planning: Data and fact gathering techniques, Feasibility reports, System Selection plan and proposal, Cost benefit and analysis, System design and modeling, Data flow Diagram, I/O from design, Modular and system design

.

Unit III:
System Implementation and maintenance: Planning consideration, System evaluation and performance, Maintenance activities, System Audit and Security.

Unit IV:
Introduction to MIS, Definition of MIS, and System approach to MIS, MIS organization with in a company, Conceptual design of MIS, System Objectives and System Constraints, Alternative System Design and Selection.

Unit V:
Detailed System design and Implementation: Basic System Design concept to MIS, Role of MIS development and System Analyst.

Reference:

1. System Analysis & Design By Awad.

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C-105 E-Commerce

CO1 : To understand the concept of e-Commerce and its Categories

CO2 : To Apply the concept of B2B, B2C

CO3 : To Synthesize the software to execute e-Commerce portal.

CO4 : To evaluate the software applications of e-Commerce

CO5 : To Explore and learn e Business and E-Commerce

UNIT 1
E-Commerce: An Introduction to E-commerce and Internet. Portal Site Development, Multimedia, 3D, Virtual reality (VRML).
UNIT 2

E-Commerce – Business to Business to Consumer, Setting up of an E-Business, Net for Trading, advertising And marketing. Secure Transaction on Net,

Unit 3
Various Protocol used on the Internet to secure the transaction, SET, SSL, Electronic Fund Transfer E Banking, Shopping Mall, Mail Service, Content Service,

Unit 4
Web Advertisement. Content Development & Deployment: News, Free Email, Chat Rooms, Search Engines, Viruses, Worm,

Unit 5
Authentication, Protection and Access Control,
Introduction to 'TALLY' software.

Reference:

E-Commerce by Kamlesh Bajaj and Nag Published by TMH

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C-201 Introduction to Data Base Management System

CO1 : To understand the concept of Data base verses File

CO2 : To Apply the concept DBMS

CO3 : To Synthesize the software to execute SQL queries

CO4 : To evaluate the software of DBMS like SQL, MySQL

CO5 : To Explore and learn advance Models of DBMS

Unit I:

Overview of Database Management System. File Oriented Approach Vs Data oriented approach. Database System. Structure of Database System. Data Independence. Primary and Secondary Objectives of Database System. Role of DBA.

Unit II:

Entity. Attributes. Tuples. E-R Diagrams. Relationships. Schema. Sub-Schema. View of Data and DBMS. Components and function of DBMS

Unit III:

Database Models : Hierarchical Model. Network Model. Relational Model. Operations on RDBMS. Examples of Different Models.

Unit IV:

Functional Dependence. Transitive Dependence. 1NF. 2NF. 3NF. BCNF.

Unit V:

SQL (DDL,DML) Object Oriented DBMS. Protection and Security Mechanism. Backup and Error Recovery.

Reference:

Introduction to Data Base Management System By Bipin Desai.

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C-202 Communication Networks

CO1 : To understand the concept of Computer Network

CO2 : To Apply the concept ISO0-OSI Layers

CO3 : To Synthesize the various Network Protocols

CO4 : To evaluate and experience the Functioning of Network Layers

CO5 : To Explore and learn Network Models

Unit I:

Introduction to Data Communication, Line Configuration, Topologies, Transmission Modes, Digital Signals, Encoding, Multiplexing
Network Hardware : Repeaters, Bridges, Routers, Gateways, Network Software, Design Issue, Interface and Services.

Unit II:

Reference Models(OSI/ISO functions of layers), TCP/IP model, Layered Architecture, Transmission Media, Wireless Transmission.

Unit III:

Ethernet, Access Method : CSMA/CD, Addressing, Frame Format, Token Bus, Token Ring: Access Method, Token Passing, Addressing Frames Format, X . 25, Frame Relay, ATM, ISDN Services: History, Subscriber Access To ISDN, Broad Band ISDN.

Unit IV:

Routing Algorithms: Shortest Path, Flooding, Flow Based, Broadcast, Distinct Vector, Link State, General Principles of Congestion Control in Virtual Circuit in Datagram Sub Net, Chock Packets, Loads Shedding, TCP/IP, IP Addressing, Sub Nets.

Unit V:

Application Layer, Network Security, Cryptography, Secret Key Algorithm, DNS, Email, Usenet, WWW, FTP,HTTP,TELNET.

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C-203 Concepts of OOPs Using C++

CO1 : To understand the concept of OOPs

CO2 : To Apply the concept of Encapsulation, Inheritance and Polymorphism

CO3 : To Synthesize the Programs of POP into OPPs

CO4 : To evaluate the OPPS programs

CO5 : To Explore and learn Constructors, Virtual Functions

Unit I:

Overview of Object Oriented Concepts. Introduction: Need of Object Oriented Programming. Object Oriented Approach. Advantages of OOPS. Characteristics of OOPL Objects, Inheritance, Reusability. New Data Types. Polymorphism Overloading.

Unit II:

An Overview of C++ Programming: C++ objects. C++ objects as data types. constructor & Destructors. Object as arguments. Overloaded constructors. member functions outside the class. objects as argument. Returning object from functions. Structure and classes. static class data. An introduction to Array. Array as a class member data. Arrays as object, strings. Arrays of string. Strings as class members. User defined strings.

Unit III:

Operator Overloading: Overloading unary operators. Overloading binary operator. Arithmetic operator. Concertinaing strings. Multiple Overloading. Comparison Operator. Arithmetic assignment Operator. Data Conversion: Conversion between (Basic Types. Object and Basic Types. Between Object of Different Classes).

Unit IV:

Inheritance: Concept of base class and derived class. accessing the base class members. derived class constructors. overriding member functions. Virtual functions. Abstract base class. Public and Private Inheritance. Template Function and Template Class.

Pointers: Pointers and Arrays. Pointers and Strings. Pointers and Functions. Memory management .New and Delete Operators. Pointer to objects. Pointers to Pointer. Linker-List Manipulation.

Unit V:

Files and Strings: Stream Class Hierarchy. String I/O. Character I/O. Object I/O. I/O with multiple objects. File Pointers (tellg). Disk I/O with member functions. Error Handling. I/O redirection IOS flags. Cerr and Clog Objects. Overloading of insertion and extraction operator. Command line arguments.

Reference:

C++ Programming by Robert Lafore

Programming in C++ by Bala Guruswamay

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C-204 Visual Programming

CO1 : To understand the concept of Window Programming

CO2 : To Apply the concept of Events and Methods

CO3 : To Synthesize the software to make Visual Programs

CO4 : To evaluate the software like Visual Studio

CO5 : To Explore and learn Visual Basics

Visual Basic InteraDesign Strategies: Enabling objects to interact using programming or scripting.

Visual Development Environment:

Identification of features: Use of advanced features to satisfy the requirements of an application features available will vary greatly between different development environments, but typical example might be the use of drag and drop, simple animation, linking to databases, Internet development.

Reference:

Using Visual Basic 6.0 by Resleman

Visual Basic 6.0 by Paul Sheriff

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C-205 Operating Systems

CO1 : To understand the concept of Operating System

CO2 : To Apply the concept Operating System to Users

CO3 : To Synthesize the software tools to develop Operating Systems

CO4 : To evaluate the software applications of Operating Systems

Unit I :

Introduction: Evolution of Operating System, Types of Operating Systems. Different views of Operating Systems, Command Language user's view, System Call User's view. Implementation of Operating System, RAM Disks, Clocks, Terminals.

Unit II :

Processes: The Process Model, Implicit and Explicit Tasking, Process Relationship. Process States, Process Switch, Threads, Scheduling Algorithms (First Come First Server, Round Robin, Shortest Process, Highest Response Ratio, Feedback-n, Priority). Mutual Exclusion, Inter-process Communication and Synchronization, Semaphores. Pessimistic and Optimistic Concurrency Control, Producers/Consumers Problem using semaphore(With bounded buffer and unbounded buffer) Critical Region, Monitors, Messages.

Unit III :

Memory Management: Contiguous Allocation, Non-Contiguous Allocation, Static and Dynamic Partitioned Memory Allocation, Paging and Virtual Memory, Page Replacement Algorithms (Optimal, LRU, FIFO, Clock, NRU, Be-lady's Anomaly), Simple Segmentation, Segmentation with paging, Disk Management, Disk Controller and Designer, Operating System's View of File Management, File Allocation Method, File Directories, File Sharing, File System & Security, Reliability, Viruses & Related Threats.

Unit IV :

Deadlocks: Conditions for deadlocks, Deadlock Prevention, Detection and Avoidance. Banker's Algorithm with single and multiple resources.

Unit V :

Features of DOS, Windows 3.1, Windows NT, Windows 95, Windows 98, Windows 2000, Design of UNIX.

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I SEMESTER
PAPER-I: FOUNDATION OF YOGA-I
Subject Code:M.A (Yoga) CC-101

UNIT- I

1. INTRODUCTION AND EVOLUTION OF YOGA

1.1 Meaning, Definition and importance of Yoga according to various schools of thoughts

1.2 Aims, Objectives and Importance of Yoga in Life

1.3 Application and Misconceptions about Yoga in Modern Society

1.4 Historical, Psychological, Mythological development and evolution of Yoga.

UNIT-II

2. YOGA IN VARIOUS PHILOSOPHIES AND TEXTS

2.1 Classification of Indian Philosophy and their basis of Division

2.2 25 eliments of Sankhya Darshana, Purusha, Prakriti and their Relationship, Yoga Darshana.

2.3 Yoga in Nyaya Darshana, Vaisheshika Darshana, Mimansha Darshana, and VedantaDarshana

2.4 Yoga in Baudha Darshana, Jain Darshana and Sufi Darshana.

UNIT-III

3. SCHOOLS OF YOGA

3.1 Introduction of Hatha Yoga , Mantra Yoga , Laya Yoga, Raja Yoga

3.2 Karma Yoga, Bhakti Yoga, Gyan Yoga

3.3 Shiv Yoga Sadhana, Swar Yoga

3.4 Tantra Yoga (Shaiva, Shaktta, Vaishnave)

UNIT –IV

4. BIOGRAPHIES OF FAMOUS YOGIS AND THEIR CONTRIBUTION IN YOGA

4.1 Maharishi Patanjali

4.2 Matsyendra Nath, HathaYogi Gorakshanath

4.3 Ramkrishna Paramhansa, Swami Vivekananda

4.4 Raman Maharishi, Maharishi Aurobindo, Paramhansa Yogananda.

Contd…..2

I SEMESTER
PAPER–II: APPLIED STATISTICS
Subject CodeM.A (Yoga) CC-102

UNIT-I

1.1 Meaning and definition of Statistics.

1.2 Nature of Data:- Four Levels of Data – Nominal, Ordinal Interval & Ratio; Graphical representation of Data: Line Diagram, Pie Diagram, and Bar Diagram Frequency Distribution: Frequency Polygon, Frequency Curve, Histrogram, Ogives.

1.3 Application of Measures of Central tendency & variability and their characteristics. Relative and absolute variability, Coefficient of variation.

1.4 Need of Statistics in Yogic sciences.

UNIT-II

2.1 Two approach to Probability: Classical & Axiomatic; Addition Theorem & Multiplication Theorem, Calculation of Probabilities.

2.2 Normal Distribution: Properties of Normal Curve, Skewness & Kurtosis, Problems based on Normal Distribution.

2.3 Developing norms in the form of grading, Percentile Scale, T- Scale, Scales based on difficulty ratings.

2.4 Sampling Distribution of Means, Standard Error of Mean, Interval estimates and Point estimates; Coefficients interval for mean.

UNIT-III

3.1 Concept of correlation & regression: Scatter diagram, linear correlation, rank correlation.

3.2 Liner regression equation with two variables.

3.3 Partial correlation coefficients of first and second order.

3.4 Multiple correlation coefficients involving three variables.

UNIT-IV

4.1 Testing of Hypothesis : Region of Acceptance & Region of Rejection null & alternative Hypotheses: Level of Significance, type I & Type II errors, one tailed & two tailed Tests, degrees of freedom, procedure in testing of hypothesis.

4.2 Large Sample test (z-test) for means for one sample and two samples; Small sample test (t-test) for means for one sample and two samples – dependent and independent samples**,** F-test

4.3 Chi- Square Test for goodness of fit and testing independence of attributes.

4.4 One way Analysis of Variance, Post- hoc Tests – LSD & Scheffe.

Contd……3

I SEMESTER
PAPER–III: BASICS OF RESEARCH METHODOLOGY IN YOGA
Subject CodeM.A (Yoga) CC-103

UNIT-I

1.1 Meaning and Definition of Research-Need Nature and Scope of Research in Yoga
1.2 Classification of Research : Basis, Applied and Action Research
1.3 Scientific Vs Unscientific methods of Problem Solving.
1.4 Identification of Research questions and Research objectives
1.5 Ethics and Qualities of good researcher.

UNIT-II

2 Methods of Research
2.1 Analytical Method of Research:
- 2.2.1 Historical Research Purpose, Steps, Advantages, Disadvantages, Sources-Primary and Secondary data, Pitfalls, Internal and External Criticism
- 2.1.2 Philosophical Research: Purpose, Methods, Inductive and Deductive Reasoning

2.2 Descriptive Method of Research:
- 2.2.1 Survey Research: Method, Process of implementing survey research methods, Questionnaire, Interview, Longitudinal and Cross-Sectional Survery Research.
- 2.2.2 Case Study: Approaches, Types of case studies

2.3 Developmental Research.

UNIT-III

3. Experimental Research and Design
3.1 Experimental Research: Meaning, Nature, Importance and Advantages
3.2 Data and its types: Metric & Non-Metric Data, Interval Data, Ratio Data, Nominal Data and Ordinal Data
3.3 Variables "Meaning, Importance, Types- Categorical variables, Continuous Variables" and Random Variables
3.4 Internal and External Validity: Meaning, Concepts, Importance, Threats to Internal & External Validity, Factors to improve internal & External Validity
3.5 Experimental Design: Pre-Experimental, True Experimental and Quasi Experimental Research Design, Internal and External Validity, Advantages of Experimental Research Design

UNIT-IV

4. Research Proposal and Report, Publication and Plagiarism
4.1 Development of Research Problem: Location of Research Problem and Criteria in selecting the research problem, Survery of Related Literature and Referencing

4.2 Research Proposal: Formatting of research proposal, Basic guidelines of writing research proposal.
4.3 Research Report: Formatting of research reports, Basis guidelines of writing research report and Abstract.
4.4 Introduction to Research Publication & Peer Review Culture
4.5 Introduction to Plagiarism, Plagiarism Detection Software (PDS) and Shodhganga

Contd……4

I SEMESTER
PAPER- IV: HUMAN ANATOMY AND PHYSIOLOGY-I
Subject CodeM.A (Yoga) CC-104

UNIT- I
1. GENERAL HUMAN ANATOMY AND PHYSIOLOGY

1.1 Introduction of Anatomy and Physiology, Anatomical Terminology and Positions.

1.2 Structure and Function of Cell, Types of Tissues, their Structure and Functions.

1.3 Brief introduction of Different Organs and Systems of Human Body.

1.4 Need and Importance of Anatomy & Physilogy in the field of Yoga.

UNIT- II
2. MUSCULO– SKELETAL SYSTEM

2.1 Skeletal System - Composition of Bone, Joints, Ligaments, Tendon.

2.2 Gross and Microscopic Structure and Function of Bone and Skeletal Muscle.

2.3 Neuromuscular Junction, Mechanism of Muscle Contraction.

2.4 Effect of Yogic Practices (Asana, Pranayama, Mudra, Bandha, Kriya and Meditation) on Muscular and Skeletal System

UNIT-III
3. CARDIO-VASCULAR SYSTEM

3.1 Structure and Functions of Heart, Cardiovascular Parameters.

3.2 Factors affecting Cardiovascular Parameters.

3.3 Effect of Yogic Practices (Asana, Pranayama, Mudra, Bandha, Kriya and Meditation) on Cardio Vascular System

3.4 Cardiovascular Diseases and their Yogic Management.

UNIT-IV

4. RESPIRATORY SYSTEM

4.1 Structure and Functions of Lungs and Respiratory Organs.

4.2 Muscles and Mechanism of Respiration, Second Wind, Oxygen Debt.

4.3 Internal and External Respiration, Respiratory Volumes and Capacities.

4.4 Effect of Yogic Practices (Asana, Pranayama, Mudra, Bandha, Kriya and Meditation) on Respiratory System and Respiratory Diseases

Contd…..5

SEMESTER-I
PRACTICAL SYLLABUS

Subject CodeM.A (Yoga) PC-101

1. SURYA NAMASKARA

2. PAWANMUKTASANA VARIATIONS

3. MEDITATIVEASANAS:

Padmasana, Siddhasana, Swastikasana, Bhadrasana, Vajrasana.

4. RELAXATION ASANAS:

Shavasana, Makarasana, Shithila Dandasana, Shithila Tadasana, Balasana, Adhvasana, Shashankasana.

5. SUPINE ASANAS:

Naukasana, Kandharasana, Pavanmuktasana, Vipareetkaraniasana, Matsyasana, Ardha Halasana, Uttanasana, Setubandhasana, Salamba Setubandhasana, Tolangulasana, Sarvangasana.

6. PRONE LYING ASANAS:

Sarpasana, Bhujangasana, Shalabhasana, Dhanurasana, Viparita Naukasana, Santulanasana (with variations).

7. SITTING ASANAS:

Paschimottanasana, Ardha Matsyendrasana, Ardha Chandrasana, Ushtrasana, Parighasana, Simhasana, Akarna Dhanurasana, Supta Vajrasana, Ekapada Shirasasana.

8. STANDING ASANAS:

Tadasana, Natarajasana, Garudasana, Utkatasana, Parivritta Utkatasana, Ekapadasana.

9. STRETCHING PRACTICES

Contd…..6

SEMESTER-I
Subject CodeM.A (Yoga) PC-102

1. SHATKARM:

a. NETI : Two types (Jal Neti and Sutra Neti)

b. DHAUTI: Two types (Kunjal Kriya and Agnisar Kriya)

2. ADVANCED GROUP OF ASANAS:

Karnapeedasana, Padmasarvangasana, Dwihasta Bhujasana, Niralamba Paschimottanasana, Vatayasana

3. PRANAYAMA:

Nadishodhana, Suryabhedi, Chandrabhedi, Ujjayi, Sheetali, Seetkari, Bhastrika, Brahmari.

4. BANDHAS & MUDRAS:

Maha Mudra, Maha Bheda Mudra, Vipareetakarni Mudra, Shanmukhi Mudra, Manduki Mudra, Ashwini Mudra, Kaki Mudra, Bhujangini Mudra, Jalandhara Bandha, Uddiyana Bandha.

5. MEDITATION- Soham Meditation, OM Meditation, Nadanusandhana Meditation

6. RELAXATION TECHNIQUES- Yoga Nidra – I, II, III.

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Contd…..7

II SEMSTER
PAPER- I: FOUNDATION OF YOGA-II
Subject Code: M.A (Yoga) CC-201

UNIT-I

1. INTRODUCTION OF VEDAS

1.1 Introduction of Vedas and Vedangas
1.2 Trayaprasthana; Purushartha Chatushtaya
1.3 Introduction to Vedamahavakyas and their Significance – Core of Vedic Knowledge
1.4 Importance of Vedic Knowledge in Modern Era

UNIT-II

2. INTRODUCTION OF UPANISHADS

2.1 Katha Upanishad: Definition of Yoga; Nature of Soul; Importance of Self Realization
2.2 Prashna Upanishad: Concept of Prana and rayi (creation); Panchapranas; The fivemain questions
2.3 Mundaka Upanishad: Two approaches to Brahma Vidya-the Para and Apara; The greatness of Brahmavidya, The worthlessness of Selfish-karma; Tapas and Gurubhakti
2.4 The origin of creation, Brahman the target of Meditation

UNIT-III

3. MESSAGES OF UPANISHADS

3.1 Ishavasyopanishad: Concept of Karmanishta; Concept of Vidya and Avidya; Knowledge of Brahman; Atma Bhava
3.2 Kena Upanishad: Indwelling Power; Indriya and Antahkarana; Self and the Mind
3.3 Katha Upanishad: Intutive realization of the truth; Truth transcendental; Moral of Yaksha Upakhyana.
3.4 Mandukya: Four States of Consciousness and its relation to syllables in Omkara: Yogic Concepts in Upanishads.
- 3.4.1 Aitareya: Concept of Atma, Universe and Brahman.
- 3.4.2 Taittiriya Upanishad Concept of Pancha Kosha; Summary of ShikshaValli; Ananda Valli Bhruguvalli.
- 3.4.3 Chandogya Upanishad: Om (udgitha) Meditation; Sandilyavidya,
- 3.4.4 Brihadaryanaka Upanishad : Concept of Atman and Jnana Yoga. Union of Atman and Paramatman

UNIT-IV

4. YOGA VASISHTHA

4.1 Highlights of Yoga Vashitha, and Concept of Adhis and Vyadhis; Psychosomatic Ailments and their genesis

4.2 The four Gatekeepers (Pillars) to Freedom, Sukhaprapti - the Highest State of Bliss; and Practices to overcome the Impediments of Yoga

4.3 Development of Satvaguna; Charachteristics of a Sadhaka

4.4 Eight limbs of Meditation; Janana Saptabhumika and Concept of Samsara and Liberation in Yoga Vasishtha.

Contd…..8

II SEMESTER
PAPER –II- PATANJALI YOGA SUTRA
Subject Code: M.A (Yoga) CC-202

UNIT – I

1. INTRODUCTION OF PATANJALI YOGA SUTRA

1.1 Introduction of Pantanjali Yoga Sutras.

1.2 Historical background of Pantanjali Yoga Sutras.

1.3 Importance of Patanjali Yoga Sutras in Modern Age.

1.4 Physical (kayasampat) Mental and Social Excellence in Yoga Sutra.

UNIT – II

2. SAMADHI PADA

2.1 Definition of Yoga, Concept of Chitta, Chitta Vritti, Chitt Bhumi.

2.2 Yogantaraya, Abhyasa-Vairagya, Iswar and Iswar Pranidhan, Vivekkhyati.

2.3 Chitta Vikshep and Chitt Prasadhan.

2.4 Samadhi-Sampragyaat Samadhi, Ritambhara Pragya, concept of Sabeej and Nirbeej samadhi.

UNIT – III

3. SADHAN AND VIBHUTI PADA

3.1 Pancha Klesha, Kriya Yoga:- Avidhya, Asmita, Raag, Devasha,Abhinivesha.

3.2 Ashtang Yoga (Bahirang Sadhana)– Yama, Niyam, Asana, Pranayam, Pratyahar.

3.3 Ashtang Yoga (Antrang Sadhana)– Dharana, Dhyana, Samadhi.

3.4 Concept of Samyama and Ashtsiddhis and its Vibhuties.

UNIT – IV

4. KAIVALYA PADA

4.1 Panch Siddhis.

4.2 Brief introduction of Karma, Types of Karma, Karmaphal Siddhanta.

4.3 Nature of Dharma and Dharmamegh Samadhi

4.4 Concept of Kaivalya.

Contd……9

II SEMESTER
PAPER-III: PRINCIPLES & PRACTICES OF HATHA YOGA
Subject Code: M.A (Yoga) CC-203

UNIT – I

1. GENERAL INTRODUCTION TO HATHAYOGA AND PRE-REQUISITES

1.1 Hathayoga: Origin, Meaning, Definition, Aim, Objectives and Misconceptions.

1.2 Hathyoga: It's Philosophy, History and development, Brief Introduction to eminent Hatha Yogis of Natha Cult and their contribution to Yoga.

1.3 General Introduction of Hathayogic taxts, Siddhasiddhantapaddhati, Hathayogapradeepika, Gherandasamhita, Hatharathnavali, Shivasamhita, Goraksasatakam.

1.4 Concept of Matha, Concept of Badhakatattva (obstacles) and Sadhakatattva (facilitator factors) in Hathayoga, Types of aspirants in Hathayoga Sadhana.Concept of Ahara and Mitahara, Pathya (conducive) and Apathya (non-conducive) in Hathayoga Sadhana, Hatha Siddhi lakshanam.

UNIT – II

2. CONCEPT OF GHATASHODANA , ASANAS INHATHAYOGA

2.1 Introduction of Shodhanakriyas in Hathayogaradeepika, Gherandasamhita and Hatharathnavali.

2.2 **Shatkarma-** Technicques, Benefits, precautions, and contraindications (Dhauti, Basti, Neti. Nauli, Trataka and Kapalbhati)

2.3 Importance of Shodhanakriyas in health, disease and Hathayoga Sadhana.

2.4 **Asanas-** Definition, concept and Techniques, Benefits, precautions, and contraindications of Asanas in Hathayogaradeepika, Gherandasamhita and Hatharathnavali

UNIT-III

3. HATHAYOGA PRACTICES: PRANAYAMA, BANDHA AND MUDRA

3.1 Introduction of Prana and Pranayama; Pre-requisites of Pranayama, Nadishodhana Pranayama, Importance of Nadishuddi.

3.2 **Pranayama-** Technicques, Benefits, precautions, and contraindications, Pranayama and Ashtakumbaka in Hathayogapradeepika Gherandasamhita and Hatharathnavali.

3.3 Importance of Pranayama in health, disease and Hathayoga Sadhana.

3.4 Introduction of Mudra (Bandha) Technicques, Benefits, precautions, and contraindications of in Hathayogapradeepika Gherandasamhita and Hatharathnavali.

UNIT–IV

4. HATHAYOGA PRACTICES: PRATYAHARA, DHARANA, DHYANA

4.1 Concept of Kand, Nadi, Swas-prashwas or Swara, and Granthi.
4.2 Concept of Shatchakra and Kundalini prabodhan, Concept of Shiva and Shakti.
4.3 Concept of Pratyahara, Dharana, Dhyana and Samdhi in Gherandasamhita.
4.4 Concept of Nada and Nadanusandhana in Hathayogaradeepika, Techniques, Benefits, precautions, and contraindications of Nadanusandhana, four stages of Nadanusandhan.

Contd…….10

II SEMSTER
PAPER- IV: HUMAN ANATOMY AND PHYSIOLOGY-II
Subject Code: M.A (Yoga) CC-204

UNIT- I

1. DIGESTIVE AND EXCRETORY SYSTEM

1.1 Organs, Glands and steps of Digestion (Structure and Functions in brief).
1.2 Excretory System.
1.3 Organs of Urinary System and their functions.
1.4 Effect of yogic practices on digestive and excretory system (asana, pranayama, mudra, bandha, kriyas and meditation).

UNIT- II

2. HORMONAL AND REPRODUCTIVE SYSTEM

2.1 Structure and Functions of Endocrine and Exocrine Glands (Adrenal, Pituitary, Pancreas and Thyroid Glands, Gonads).
2.2 Homeostasis.

2.3 Reproductive System.
2.4 Effect of yogic practices on endocrine and reproductive system (asana, pranayama, mudra, bandha, kriyas and meditation).

UNIT -III

3. NERVOUS SYSTEM

3.1 Nervous System: Structural and Functional Divisions of Nervous System– PNS, ANS, CSF.
3.2 Structure and Functions of Brain, Spinal Cord, Syneptic Nobe, Acetylecholine.
3.3 Effect of yogic practices on nervous system (asana, pranayama, mudra, bandha, kriyas and meditation).
3.4 Concept of Brain Wave, Pattern of Brain Wave during Pranayama and Meditation & their benefits in Human Psycho-Physiological Functioning.

UNIT -IV

4. PHYSIOLOGY OF METABOLISM

4.1 Metabolism of Carbohydrates, Fat, Protein.
4.2 Aerobic and Anaerobic activities (metabolism).
4.3 Calorimetry: energy requirement and its calculation.
4.4 Energy aspects of diet and their distribution.

Contd…..11

SEMESTER-II
Practical Syllabus
Subject Code: M.A (Yoga) PC-201

1. SHATKARM:

1. Kapalbhati Three Types (Vyutkarma, Sheetkarma and Vaatkarma)
2. Tratak Three Types (Antah Bahir Adho)
3. Danda Dhauti, Vastra Dhauti
4. Nauli (Madhyama ,Vama, Dakshina)
5. Lagooshankha Prakshalana

2. INTERMEDIATE PRACTICES

3. VINYASA SURYA NAMASKARA

4. SUKSHAMA AND STHUL VYAYAMA

5. MEDITATIVE ASANAS (according to Gherand Samhita):
Guptasana, Virasana, Sankatasana

6. RELAXATION ASANAS:
Matsya Kridasana, Yoga Mudrasana, Markatasana,

7. SUPINE LYING ASANAS:
Halasana, Chakrasana, Salambasetubandha Sarvangasana, Utthita Supta Padangushthasana, Supta Kapotasana

8. PRONE LYING ASANAS:
Bhekasana, Purna Dhanurasana, Purna Bhujangasana, Chaturanga Dandasana, Ekapada Adhomukha Shvanasana

9. SITTING ASANAS:
Vyaghrasana, Mandukasana, Bakasana, Gomukhasana, Garbhasana, Rajkapotasana, Marichyasana I.

10. STANDING ASANAS:
Tadasana, Tiryaka Tadasana, Katichakrasana, Vrikshasana, Trikonasana, Ardha Kati Chakrasana, Virbhadrasana- I, II, III.

11. ADVANCE GROUP OF ASANAS:
Kurmasana, Uttana Kurmasana, Hanumanasana, Ashta Vakrasana, Vishwamitrasana

12. PRANAYAMA:
Ashta Kumbhaka according to Hatha Yoga Pradipika

13. BANDHAS AND MUDRAS:
Mool Bandha, Maha Bandha, Khechari Mudra, Shakti Chalini Mudra, Tadagi Mudra, Pashinee Mudra, Matangini Mudra

Contd…..12

14. MEDITATION TECHNIQUES:
Amritvarsha Dhyan, Divya Anudaan Dhyan

15. RELAXATION TECHNIQUES:
DRT (Deep Relaxation Technique)

Subject Code: M.A (Yoga) PC-202

TEACHING ABILITY (LESSON PLAN-I) MINIMUM 5

(i) Teaching Ability Lesson Plans shall be practical based.

(ii) There will be minimum four and maximum five Internal Lessons.

(iii) All Lesson will be maintained in a single practical file along with the final lesson.

(iv) Internal Lessons shall be assessed out of 25 and final lesson shall be of 75 marks.

(v) Internal Lessons should be taken based on the practical syllabus of Yoga.

(vi) Final Lesson should be taken on any topic of their choice out of practical syllabus of Yoga.

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Dept. of Mathematics
Dr. Bhimrao Ambedkar University, Agra
M.Sc. (Mathematics) as per NEP-2020

C–1: Advance Abstract Algebra

Recall: Groups, Subgroups, Cyclic Groups, Permutation Groups, Cayley's Theorem, Lagrange's Theorem, Normal subgroups, Quotient Groups, Homomorphism, Isomorphism Theorems, Direct Products. Conjugate elements and Class Equation of Finite groups Cauchy's theorem, Sylow's Theorems, Polynomial Rings, Quotient Rings, Ideals, Maximal Ideals, Prime ideals, integral domains, Unique Factorization domains, Principal Ideal Domains Euclidean Domains. Fields and Field extensions, Galois Fields, Solvability of Polynomials by Radicals.

C–2: Ordinary Differential Equations and Partial Differential Equations

Ordinary Differential Equations (ODEs): Existence and uniqueness of solutions of initial value problems for first-order ordinary differential equations, singular solutions of first-order ODEs, and the system of first-order ODEs. The general theory of homogenous and non-homogeneous linear ODEs, variation of parameters, Sturm-Liouville boundary value problem, Green's function.

Partial Differential Equations (PDEs): Lagrange and Charpit methods for solving first-order PDEs, Cauchy problem for first-order PDEs. Classification of second-order PDEs, General solution of higher order PDEs with constant coefficients, Method of separation of variables for Laplace, Heat and Wave equations.

C–3: Probability and Statistics

Probability: Baye's theorem, probability mass and density function, distribution function, moments generating function.

Probability distribution: Uniform, Binomial, Hypergeometric, Poisson, Rectangular, Gamma, Beta, Exponential, Normal.

Test of significance based on χ^2.

Sampling (Large sample), test of significance based on t, F and Z.

C–4: Computational Numerical Methods

Error analysis, Numerical solution of algebraic and transcendental equations, Newton-Raphson method, fixed point iteration.

Interpolation: existence and error of polynomial interpolation, Lagrange, Newton, Hermite (Oscillatory), cubic spline Interpolations, Numerical differentiation and integration, Trapezoidal and Simpson rule, Gaussian quadrature; (Gauss-Legendre and Gauss-Chebyshev).

Numerical solution of systems of linear equations: direct and iterative methods, (Jacobi Gauss-Seidel and SOR) with convergence.

Matrix eigenvalue problems: Jacobi and Given's methods. Numerical solution of ODE: initial value problems, Taylor series method, Runge-Kutta methods, predictor-corrector methods, Numerical solutions of PDE (finite difference method), Schmidt, Lassonnen, Crank-Nicolson, Richardson, DuFort and Frankel Methods. Convergence and stability

C-5: Minor

C–6: Real Analysis

Dedekind's Theory: Real rational and real irrational numbers, ordering of real numbers, Archimedean property, Trichotomy law, insufficiency of rational numbers.

Riemann Stieltjes Integration: Riemann integration as a special case of Riemann Stieltjes integration, Darboux's theorem, Algebra of integrable functions, Continuity and differentiability of the integral function, Fundamental theorem of Calculus.

Uniform Convergence: Sequences and series of functions, pointwise and uniform convergence, Abel and Dirichlet tests for uniform convergence, Uniform convergence and continuity, Uniform Convergence and Riemann integration, Uniform convergence and Differentiation, Cauchy criterion for Uniform convergence, Weierstrass M – test for uniform convergence.

Euclidean Spaces: Algebraic structure of R^n, Geometrical representation of R^n, Triangle inequality, Neighborhood of a point, limit point of a set, Open and closed sets in R^n, Bounded and compact sets in R^n, Bolzano Weierstrass Theorem, Heine Borel Theorem, Sets with Heine Borel Property.

Real valued functions of several real variables: Limit and continuity of functions of several variables, Algebra of continuous functions, compactness preserving the character of continuous function, Partial derivatives, Partial Derivatives of higher order, Schwarz's and Young's theorem.

C-7: Functional Analysis

Linear spaces, Dimension of a linear space.

Norm and Normed linear spaces, Completeness, Banach Spaces, Convex sets in Normed linear spaces, Quotient spaces.

Linear Operators: Elementary properties, Linear operators in finite dimensional space, Spaces of continuous linear operators, Boundedness and continuity of linear operators.

Inner product space: Simple properties, Hilbert space, Orthogonal complements, Projections, Orthonormal Basis, Bessel's inequality, Parseval identity, Self-adjoint operators, Normal operators and Unitary operators. Hahn-Banach theorem, Open mapping theorem, Closed graph theorem and Spectral theorem for normal operators.

C-8: Mathematical Modeling

Role of Mathematics in problem-solving, Problem definitions, System Characterizations, Mathematical Modeling, Mathematical formulations, Analysis of MF (Dynamic, Static, and Stochastic formulations and its analysis), Simulations, Parameter Estimations, Design of Experiments, Validations.

C-9: Inventory and Queueing Theory

Inventory policy, The concept of EOQ, Deterministic inventory models with shortage and no shortage, multi-items deterministic problems, Dynamic order Quantity, Inventory problem with uncertain demand, One Periodic problem without a setup cost and with setup cost.

Queueing system, Queueing models, Birth-Death models, M/M/1:∞, M/M/1:N, M/M/C:∞ M/M/C:N, M/E_k/1:∞, M/G/1:∞.

C-10: Practical

Problems of Numerical Methods & Operations Research through 'C' and 'C++'.
Numerical Integration, Solution of ODE, Solution of System of Linear Equations, Solutions of LPP, Solution of Inventory Problems

C–11: Topology

Definitions and examples of topological spaces, closed sets, closure of a set, dense subsets, Kuratowski closure axioms, neighbourhood of a point, interior, exterior, frontier (Boundary), accumulation (limit) point and derived sets, the basis for topology, order topology, subspace topology, continuous functions and homeomorphism, product topology.

Connected spaces, connected subspaces of real line, components and locally connected spaces, compact spaces, compact subspaces of the real line.

Countability axioms, separation axioms, normal spaces.

Urysohn's lemma, Urysohn's metrization theorem, Tychonoff's theorem, Stone-Cech compactification (Statement only).

C–12: Fuzzy Sets and Fuzzy Logics

Fuzzy sets: Basic definitions, $\propto -$level sets, convex fuzzy sets, basic operations on fuzzy set types of fuzzy sets, Cartesian products, algebraic products, bounded sum and difference, norm and t-conorms. Intuitionistic fuzzy set and hesitant fuzzy set.

The extension principle. Zadeh's extension principle of fuzzy sets, image and inverse of fuzzy sets. Fuzzy numbers, elements of fuzzy arithmetic.

Fuzzy relations and Fuzzy Graphs: Fuzzy relations of fuzzy sets, the composition of fuzzy relations, min-max composition and its properties, fuzzy equivalence relations, fuzzy compatibility relations, fuzzy relation equivalences, fuzzy graphs, similarity relation.

Possibility Theory: fuzzy measure, evidence theory, necessity measure, possibility measure, possibility distribution, possibility theory and fuzzy sets, possibility theory versus probability theory.

Fuzzy logic: An overview of classical logic, multi-valued logic, fuzzy propositions, fuzzy quantifiers, linguistic variables and hedges, inference from conditional fuzzy propositions, and the compositional rule of inference.

C–13: Mathematical Programming

Fundamental properties of solutions for linear programming, Revised simplex method, Parametric linear programming, Linear fractional programming, Dual simplex method, Integer programming, Post optimality analysis, Non-linear programming, Kuhn-Tucker conditions of optimality, Quadratic programming, method due to Beale, Wolfe and duality in Quadratic programming.

C-14: Elective-I

Discrete Mathematics

Formal Logic: Statements, Symbolic representation and tautologies, Quantifiers, Predicates and Validity, Propositional Logic.

Lattices: Lattices as partially ordered sets, their properties, Lattices as algebraic system, Sub-lattices, Direct products, and homomorphisms, some special lattices, e.g. complete, complemented and distributive lattices.

Boolean Algebra: Boolean Algebras, as Lattices, Various Boolean identities, The switching algebra example, subalgebras, direct products and homomorphisms, join – irreducible elements, stoms and minterms, Boolean forms and their equivalence, minterm Boolean forms, Sum of products canonical forms, minimization of Boolean functions, application of Boolean algebras to switching theory, The Karnaugh map method.

Graph Theory: Definition of (undirected) Graphs, Path, Cycles, and subgraphs, induced subgraphs, degree of vertex, connectivity, planar graphs and their properties, trees, Euler's formula for connected planar graphs, complete and complete bipartite graphs Kuratowski's theorem (Statement only) and its use, spanning trees, cut-sets, fundamental cut-sets, and circuits, minimal spanning trees and Kruskal's algorithm, matrix representations of graphs, Euler theorem on the existence of Eulerian paths and circuits, directed graphs, in-degree and out-degree of a vertex, weight undirected graphs, Dijktra's algorithm, strong connectivity and Warshall algorithm, directed trees, search trees, tree traversals.

Financial Mathematics

Financial market and derivatives. Binomial Model: Binomial and CRR model, pricing a European and American contingent claim. Finite market model: Definition, First and second fundamental theorem of Asset pricing, pricing European contingent claims. Incomplete markets, Separating hyperplane theorem.

Black-Scholes model, Equivalent martingale measure. European call option-Black-Scholes formula. American call and put option.

Multi-dimensional Balck-Scholes model: First fundamental theorem of asset pricing. Form of equivalent local martingale measures. Second fundamental theorem of Asset pricing. Pricing European contingent claims. Incomplete markets.

Reliability Theory

Reliability Definition, Failure data analysis, Hazard Models, System Reliability. Series, Parallel, Mixed configuration complex systems, MTBF, Markov models. Reliability Improvement, Redundancy optimization, fault Tree Analysis, Tie set Cutset, Reliability using Boolean Algebra, Maintenance and Availability, Repairable System. Reliability allocation application. Application of Reliability theory.

Coding Theory

Introduction to coding theory, detection and correction of errors, MLD, error-correcting coding and detecting coding. Linear codes, algebraic definitions and concepts, generating and parity check matrices, property of linear codes, MLD for linear codes, Perfect and related codes, some bounds for codes, Hamming codes, extended codes, extended Golay codes, Golay codes, Reed-Muller code, Cyclic linear codes, polynomials representation of words, generating parity check matrices for cyclic codes, Dual cyclic codes, BCH codes, Finite fields, Cyclic Hamming codes, Reed Solomon, codes over $GF(2^r)$.

Summability Theory

Special methods of summation: Nörlund means, Regularity and consistency of Nörlund means, Inclusion, Equivalence, Euler means, Regularity of (E,1) method, Abelian means, Regularity of (A,λ) method, A-method and its regularity, A Theorem of inclusion for Abelian means, Complex methods, Summability of 1-1+1-… by special Abelian Methods, A theorem of consistency, Methods ineffective for the series 1-1+1-… , Riesz's Typical means.

Arithmetic means: Hölder's means, Simple theorems concerning Hölder Summability, Cesàro means, Simple theorems concerning Cesàro summability, Cesàro and Abel summability, Cesàro means as Nörlund means, Equivalence Theorem, Reisz's arithmetic means, Uniformly distributed sequence, Tauberian theorems for Cesàro summability.

The Methods of Euler and Borel: The (E,q) method, Simple properties of the (E,q) method, The formal relation between Euler's and Borel's methods, Borel's Methods, Normal, absolute and regular summability, Abelian Theorems for Borel's summability.

C-15 Practical

Computer Programming with 'MATLAB'

Problems of Operations Research through 'MATLAB'.

Problems of Numerical Methods through 'MATLAB'.

C–16: Complex Variables

Analytic Functions, Power series, absolute convergence, Cauchy Hadamard Theorem.

Bilinear transformations, angle preserving property of Analytic mappings, Isogonal and Conformal mapping.

Complex integration: integral along an oriented curve, Sufficient condition for integrability, ML inequality, Cauchy Goursat Theorem for simply connected and multiply connected domains, Cauchy integral formula, Poisson's integral formula, Taylor's theorem, Morera's Theorem, Liouville's Theorem, Theorem of the Arithmetic Mean, Maximum Modulus Principle.

Singular points: Isolated character of zeros of an analytic function, Laurent series, absolute convergence and analyticity of Laurent's series, Laurent's theorem, Removable singularity, Pole and essential singularity, Behavior of a function near an isolated essential singularity, behavior at infinity.

Meromorphic Functions: Definition, characterization of Polynomials as Entire functions and Rational functions as Meromorphic functions, Residue at an isolated singularity Residue at infinity, Residue Theorem, number of zeros and poles in a domain, Principle of argument, Rouche's theorem, Fundamental theorem of Algebra.

Calculus of Residues: Evaluation of some real integrals.

C–17: Fluid Dynamics

Kinematics: Lagrangian and Eulerian methods, Equation of continuity, Boundary surface, stress lines, path lines and streak lines, velocity potential and irrotational motions, vortex lines.

Equation of Motion: Lagrange's and Euler's equations of motion, Bernoulli's theorem, equation of motion of flux method, equation referred to moving axes, impulsive actions, stream function, irrotational motion in two-dimensions, complex velocity-potential,

sources, sinks, doublets and their images, conformal mapping Milne-Thompson circle theorem.

Two-dimensional irrotational motion produced by the motion of circular, co-axial and elliptic cylinders in an infinite mass of liquid, the kinetic energy of the liquid, theorem of Blasius motion of a sphere through a liquid at rest at infinity, liquid streaming past a fixed sphere, equation of motion of a sphere, Stoke's stream function.

Stress component in a real fluid, relations between rectangular components of stress, the connection between stresses and gradients of velocity, Navier-Stoke's equation of motion, plane Poiseuille and through tubes of the uniform cross-section in form of a circle, annulus unsteady flow over a flat plate.

C-18: Elective-II

C-19: Elective-III

Number Theory and Cryptology

Euclidean algorithm. Quadratic residues and Reciprocity. Some simple cryptosystems. DES and AES systems. Public key cryptosystems, Diffie-Hellman key exchange, RSA and ElGamal systems. Signature Schemes, Elliptic curve, Crypto systems.

Calculus of Variations and Integral Equation

Calculus of Variations: Variation of a functional, Euler-Lagrange equation, Necessary and sufficient conditions for extrema. Variational methods for boundary value problems in ordinary and partial differential equations.

Linear Integral Equations: Linear integral equation of the first and second kind of Fredholm and Volterra type, Solutions with separable kernels. Characteristic numbers and eigen functions, resolvent kernel.

Wavelet Analysis

The Scalable Structure of Information: The New Mathematical Engineering, Good Approximations, Wavelets: A Positional Notation for Functions, Review of linear algebra: Vector spaces, basis, dimension, linear transformations, matrices and digitalization, inner products and orthonormal bases. Wavelet Theory: Algebra and Geometry of Wavelet: Matrices, One-Dimensional Wavelet Systems, Examples of One-Dimensional Wavelet Systems, Higher Dimensional, Wavelet Systems. Wavelets on Z, Z_n, l^2(Z), Fourier series, transform and convolution on l*2.

Wavelet Approximation and Algorithms: The Mallat Algorithm

Control Theory

Mathematical models of control systems, State space representation, Autonomous and non-autonomous systems, State, transition matrix, Peano series Solution of a linear dynamical system. Block diagram, Transfer function, Realization, Controllability, Kalman theorem, Controllability Grammian, Control computation using Grammian matrix, Observability, Duality theorems. Discrete control systems, Controllability and Observability results for discrete systems. Companion form, Feedback control, State observer, Realization. Liapunov stability, Stability analysis for linear systems, Liapunov theorems for stability and instability for nonlinear systems, Stability analysis through Linearization, Routh criterion, Nyquist criterion, Stabilizability and detachability, State feedback of multivariable system, Riccatti equation, Calculus of variation, Euler-

Hamiltonian equations, Optimal control for nonlinear control systems, Computation of optimal control for linear systems. Control systems on Hilbert spaces, Semi group theory, Mild solution, Control of a linear system

Bio-mathematics

Epidemic models: Deterministic models without removal, a general deterministic model with removal, a general deterministic model with removal and immigration, and control of an epidemic. Mathematical models in Pharmacokinetics: basic equations and their solutions, solutions for special cases, determination of transfer coefficients and compartment volumes, mathematical techniques used in compartment analysis, stochastic compartment models. Models for blood flow some basic concepts for fluid dynamics, basic concepts about blood, cardiovascular system and blood flows, steady non-Newtonian fluid flow in circular tubes, Newtonian pulsatile flows in rigid and elastic tubes, blood flow through the artery with mild stenosis, peristaltic flow in tubes and channels, models for air flow in lungs, Diffusion and Diffusion-reaction models, the diffusion equations, oxygen diffusion living tissues. Non-linear populations growth models, models in genetics, the basic model for inheritance, models for genetic improvement, selection and mutation, applications in ecology

Soft Computing

Neural Networks-1(Introduction & Architecture) Neuron, Nerve structure and synapse, Artificial Neuron and its model, activation functions, Neural network architecture: single layer and multilayer feed forward networks, recurrent networks. Various learning techniques; perception and convergence rule, Auto-associative and hetro-associative memory.

Neural Networks-II (Backpropagation networks) Architecture: perceptron model, solution, single layer artificial neural network, multilayer perception model; back propagation learning methods, the effect of learning rule co-efficient; backpropagation algorithm, factors affecting backpropagation training, applications.

Fuzzy Logic –Basic Concepts of fuzzy sets and logic, Membership functions, interference in fuzzy logic, fuzzy if-then rules, Fuzzy implications and Fuzzy algorithms, Fuzzyfications & Defuzzificataions, Fuzzy Controller, Industrial applications.

Genetic Algorithm(GA) Basic concepts, working principle, procedures of GA, flow chart of GA, Genetic representations, (encoding) Initialization and selection, Genetic operators, Mutation, Generational Cycle, and applications.

Special Function

Series solution of second order linear differential equations: Ordinary and singular points of a linear differential equation, The point at infinity, Series solution near regular singular point.

The Gamma and Beta functions: Definitions and basic properties.

Hypergeometric Functions: The hypergeometric series, An integral formula for the hypergeometric series, The hypergeometric equation, Linear relations between the

solutions of the hypergeometric equation, Relations of contiguity, and The confluent hypergeometric function.

Legendre Functions: Legendre polynomials, Recurrence relations for the Legendre polynomials, The formulae of Murphy and Rodrigues, Series of Legendre polynomials, Legendre's differential equation.

Bessel Functions: The origin of Bessel functions, Recurrence relations for the Bessel coefficients, Series expansion for the Bessel coefficients, Integral expressions for the Bessel coefficients, The additional formula for the Bessel coefficients, Bessel's differential equation.

Hermite Functions: The Hermite polynomials, Hermite differential equation, Hermite functions.

Measure Theory

Introduction and Motivation of Measure theory, Motivation and definition of Lebesgue outer measure on R^n. Properties of Lebesgue outer measure on R^n, Caratheodory extension theorem.

Lebesgue measurability, Vitali and Cantor sets, Boolean and sigma algebras

Abstract measure spaces with examples: Borel and Radon measures, Metric outer measures, Lebesgue-Stieljes measures, Hausdorff measures and dimension.

Measurable functions and abstract Lebesgue integration, Monotone convergence theorem, Fatou's lemma, Tonnelli's theorem

Borel-Cantelli Lemma, Dominated convergence theorem, the space L^1. Various modes of convergence and their interdependence.

Riesz representation theorem, examples of measures constructed via RRT. Product measures and Fubini-Tonnelli theorem. Hardy-Littlewood Maximal inequality and Lebesgue's differentiation theorem.

Dr. B. R. Ambedkar University, Agra

(Formerly : Agra University, AGRA)

CURRICULUM FOR

MASTERS OF PHYSICAL EDUCATION AND SPORTS (M.P.E.S.) PROGRAMME

TWO YEAR - (FOUR SEMESTERS)

ORDINANCE, REGULATIONS AND SYLLABUS FOR M.P.E.S. (CBCS)

Preamble :

Master of Physical Education and Sport (M.P.E.S.) two years (Four Semesters Choice Based Credit System) program is a professional program meant for preparing teachers of physical education at highereducation and professional jobs at university and sports industries.

M.P.E.S. program is designed to integrate the study of subject knowledge, pedagogical knowledge, andthe aim of Physical Education and communication of games and sports skills. The program comprises of compulsory and optional theory as well as practical courses and compulsory internship.

A) M.P.E.S.

a. 1. Eligibility

I For Admission

A) Candidate seeking admission to M.P.E.S. program must satisfy the following conditions.

B) He/She must be B.P.Ed., B.P.E.S or B.Sc. (Health & Physical Education) from University

C) He/She must have taken at least 55% marks in B.P.Ed,/B.P.E.S/B.Sc (Health & Physical Education) B.A. Physical Education as a Elite Subject Candidate belonging to scheduled cast scheduled tribe would be given concession of 5% marks in the minimum marks required for admission or eligibility criteria of Dr.B.R.Ambedkar University, Agra Admission ordinance.

D) Admission shall be made on merit on the basis of marks obtained in the entrance test (written test, sports proficiency test, physical fitness test & marks obtained in the qualifying examination) or any other selection process as per the policy of University of Dr.B.R.Ambedkar University, Agra Admission ordinance.

E) The provision of seats and the relaxation in qualifying marks for SC/ST/OBC and other categories shall be as per the rules of the central government/state government. Whichever is applicable.

F) Graduation with 45% marks and at least three years of teaching experience (for deputed in service candidates i.e trained physical education teachers/coaches)

II For the M.P.E.S. Degree : The candidates shall have subsequently undergone the prescribed course of study in the university department or a college affiliated to his University for a period of not less than two academic years, passed the examinations prescribed and fulfilled such conditions as have been prescribed there for M.P.E.S.

b .2. Duration :

The M.P.E.S. program shall be of duration of two academic years, that is, four semesters. However, the students shall be permitted to complete the program requirements within a maximum of three years from the date of admission.

3. The CBCS System:

All Programs shall run on Choice Based Credit System (CBCS). It is an instructional package developed to suit the need of students, to keep pace with the developments in higher education and the quality assurance expected of it in the light of liberalization and globalization in higher education.

4. Course :

The term course usually refereed to, as 'papers' is a component of a program. All courses need not carry the same weight. The courses should define learning objectives and learning outcomes. A course may be designed to comprise Lecturer/tutorials/ laboratory work/fieldwork/Outreach activity (Educational Tours activities)/ project work/vocational training/viva/seminars/term papers/assignments/ presentations/self-study etc. or a combination of some of these.

5. Courses of Program:

The M.P.E.S. Program consists of a number of courses, the term 'Course' applied to indicate a logical partof subject matter of the Program and is invariably equivalent to the subject matter of a "paper" in the conventional sense. The following are the various categories of courses suggested for the M.P.E.S. Program.

6. Semesters:

An academic year is divided in to two semesters, each semester will consist of 17-20 weeks of academic work equivalent to 100 actual teaching days excluding examination days. The odd semester may be scheduled from June/July to December/January and even semester from December/January to June/July. The institution shall work for a minimum of 36 working hours in a week (five or six days a week).

7. Working Day:

There shall be at least 200 working days per year exclusive of admission and examination processes etc.

8. Credits:

The term 'Credit' refers to a unity by which the program is measured. It determines the number of hours of instructions required per week. One credit is equivalent to one hour of teaching (lecture or tutorial) or one and half/ two hours of practical work/field work per week. The term 'Credit' refers to the weight given to a course. Usually in relation to the instructional hours assigned to it. The total minimum credits, required for completing a M.P.E.S. Program is 90 credits and for each semester 20 credits.

9. Examinations:

i. There shall be examinations at the end of each semester, for first semester in the month of December/January: for second semester in the month of May/June. A Candidate who does not pass the examination in any Subjects shall be permitted to appear in such failed subjects in the subsequent examinations to be held in November/December or May/June.

ii. A candidate should get enrolled/registered for the first semester examination. If enrollment/registration is not possible owing to shortage of attendance beyond condition limit/rules prescribed OR belated joining OR on medical grounds, such candidates are not permitted to proceed to the next semester. Such candidates shall redo the semester in the subsequent term of the semester as a regular student; however, a student of first semester shall be admitted in the second semester, if he/she have successfully kept the term in first semester.

10. Conditions:

Student must have 75% of attendance in each course for appearing the examination. Students who have 74% to 65% of attendance shall apply for condition in the prescribed form with the prescribed fee. Students who have 64% to 50% of attendance shall apply for condition in prescribed form with the

prescribed fee along with the Medical Certificate. Student who participate in sports competition affiliated by IOA shall apply be considered in examination with the permission of head of the department. Students who have below 50% of attendance are not eligible to appear for the examination.

11. Pattern of Question Papers:

Question Papers shall have five questions corresponding to four unit s of each theory course.

M.P.E.S. : Format of Questions Paper For 4 Units

Each question paper shall have five questions. The pattern will be as follows:

Question No.	Description	Marks
1	**Answer in detail (Long Question)** **Or** **Answer in detail (Long Question) (Form Unit 1)**	15
2	**Answer in detail (Long Question)** **Or** **Answer in detail (Long Question) (Form Unit 2)**	15
3	**Answer in detail (Long Question)** **Or** **Answer in detail (Long Question) (Form Unit 3)**	15
4	**Write short notes: any two out of four** **(Form Unit4)**	15
5	**M.C.Q. Type Questions (10 out of 12 Question)** **(3 Questions. from each unit)**	10
Total		70

12. Evaluation :

The performance of a student in each course is evaluated in terms of percentage of marks with a provision for conversion to grade point. Evaluation for each course shall be done by a continuous.

Internal assessment (CIA) by the concerned course teacher as well as by end semester examination and will be consolidate at the end of course. The components for continuous internal assessment are;

One Test	**15 Marks**
Seminar/Quiz	**5Marks**
Assignments	**5Marks**
Attendance	**5Marks**
Total	**30 Marks**

Attendance shall be taken as a component of continuous assessment, although the students should have minimum 75% attendance in each course. In addition to continuous evaluation component, the end semester examination, which will be written type examination of at least 3 hours duration, would also for man integral component of the evaluation. The ratio of marks to be allotted to continuous internal assessment and to end semester examination is 30:70. The evaluation of practical work, wherever applicable, will also be based on continuous internal assessment and on an end-semester practical examination.

13. Minimum Passing Standard:

The minimum passing standard for CIA (Continuous Internal Assessment) and External Examinations shall be 40%, i.e. 12 marks out of 30 marks and 28 marks out of 70 marks respectively for theory course. The minimum passing for both CIA & external examination shall be 50%, i.e. 15 marks out of 30 and 35 marks out of 70 Marks for the practical courses.

14. Award of the M,.P.E.S. Degree:

A candidate shall be eligible for the award of the degree of the M.P.E.S. Only if he/she has earned the minimum required credit.

15. Assessment and Evaluations:

TOTAL MARKING SYSTEM

[SEMESTER	THRORETICAL	PRACTICAL	CREDITS
Semester – 1	**400**	**200**	**24**
Semester – 2	**400**	**200**	**24**
Semester – 3	**400**	**200**	**24**
Semester – 4	**400**	**200**	**24**
Total	**1600**	**800**	**96**

I. Each course will be assessed on the basis of 100 marks. The marks would be divided between internal and external assessment.

II. There shall be one end semester external examination for each course in every semester consisting of 70% (70 marks) weight in theory and 75% (75 marks) in practical courses.

III. Each Theory course shall have internal assessment of 30% weight age on the

followingInternal written test - 15% (15 marks) Attendance - 05% (5 marks)

Class participation in assignments- 05% (5 marks) Presentations (Seminars) /quizzes etc. - 05% (5 marks)

Total 30 marks

IV. Each Practical Course shall have internal assessment of 50% weight age on the

followingOne Test 15 marks Project 10 marks

Attendance 05 marks

Total 30 marks

- The University examination in Thesis for Semester IV shall consist of the examination of the thesis. One internal examiner shall evaluate the thesis out of maximum of 30 marks and one external examiner who shall evaluate the thesis out of maximum of 70 marks. There shall be a viva-voce at internal and external examination of 70 marks.

V. Every student will be required to pass the external examination and internal assessment separately in each course.

VI. The minimum passing standard will be 40% for the external and internal component of each theory course, i.e. 28 marks out of 70 and 12 marks out of 30 .In practical minimum passing standard will be 50%for the external exam and internal assessment for each practical course.

VII. Attendance shall be taken as a component for continuous assessment, although the students should put in minimum of 75% attendance in each course. In addition to continuous evaluation component, the end semester examination, which will be written type examinations of at least 3 hours duration, would also form an integral component of the evaluation. The ratio of marks to be allotted to continuous internal assessment and to end semester, examination is 30: 70 in theory &25: 50 in practical.

VIII. (A) The grades for each course would be decided on the basis of the percentage of marks obtained in the end-semester external and internal examinations as per the following table:

Percentage	Grade Point	Grade	Description	Classification of final result
85 & above	8.5-10.0	O+	Outstanding	First class with Distinction
70-84.99	7.0-8.49	O	Excellent	
60-69.99	6.0-6.99	A	Very Good	First Class
55-59.99	5.5-5.99	B+	Good	Higher Second Class
48-54.99	4.8-5.49	B	Fair	Second Class
36-47.99	3.6-4.79	C	Average	Pass Class
Below 36	0.0	D	Fail/Dropped	Dropped

IX. The semester grade point average (SGPA) will be calculated as a weighted average of all the grade point of the semester courses. That is Semester grade point average (SGPA) = (sum of grade points of all six courses of the semester) / total credit of the semester as per example given below:

Course No	Credit	Marks out of 100 (%)	Grade	Grade Point	Credit Grade point
Course -1	4	65	A	6.5	26
Course -2	4	60	A	6.0	24
Course -3	4	62	A	6.2	24.8
Course -4	4	57	B+	5.7	22.8
Course -5	4	55	B+	5.5	22
Course -6	4	72	O	7.2	28.2
Total	24				147.8

Examples: Conversion of marks into grade points

65=60+5=6.0+5x(0.99/9.99)=6.0+5x0.1=6.0+0.5=6.5

57=55+2=5.5+2x(0.49/4.99)=5.5+2x0.1=5.5+0.2=5.7

72 = 70 + 2 = 7.0+ 2 x (1.49 /14.99) = 7.0 + 2 x 0.1 = 7.0 +0.2 = 7.2

X. SEMESTER GRADE POINT AVERAGE (SGPA) = Total Credit Grade Points = 147.8 /24 =6.16 SGPA Sem. I=

6.16 SGPA Sem. II = 5.63
SGPA Sem. III = 6.01
SGPA Sem. IV = 5.50

Total SGPA = 23.30

Cumulative Grade Point Average (CGPA) =23.30
4 = 5.82 CGPA = 5.82 Grade = B+ Class = Higher Second Class

GPA X 10 = Percentage e.g. 5.82 X 10 = 58.2 %

Note:

(1) SGPA is calculated only if the candidate passes in all the courses i.e. get minimum C grade in all the courses.

(2) CGPA is calculated only when the candidate passes in all the courses of all the semesters.

XI. The cumulative grade point average will be calculated as the average of the SGPA of all the four semesters, as shown above.

XII. Forth award of the class, CGPA shall be calculated on the basis of:

(a) Marks of End Semester External Examination And

(b) Total Marks obtained (Marks of End Semester External Examination

+ Marks of Internal Assessment) for each course. The final Class for M.P.E.S. Degree shall be awarded on the basis of lowest CGPA (marks) of (a) & (b) of one to fourth semester examinations.

16. Conferment of the M.P.E.S. Degree:

(i) A candidate shall be eligible for the conferment of the Degree of M.P.E.S. only if he/she has earned the minimum required credits for the program prescribed therefore (i.e. 96 Credits).

17. End Semester Examination:

(i) The University shall conduct the external Examination for the Semester-I, II, III & IV. The internal examination shall be conducted by the concerned Departments.

M.P.E.S. Semester-1

Part A: Theoretical papers

Examination Evaluation

Course code	Title of papers	Credit	Internal marks	External marks	Total marks
cc-101	Research methods in physical education	4	30	70	100
cc-102	Health education	4	30	70	100
cc-103	Information technology in physical education and sports	4	30	70	100
cc-104	Elective course(any one) sports journalism/ sports sociology	4	30	70	100

Part –B Practical course

Course code	Title of papers	Credit	Internal marks	External marks	Total marks
Pc-101	Athletics (running events)	4	30	70	100
Pc -102	Kho kho, football, hockey basketball, badminton kabaddi (anyone out of these) sports theory, skills techniques and officiating	4	30	70	100
	Total	24	180	420	600

M.P.E.S. Semester-IInd

Part A: Theoretical papers

Examination Evaluation

Course code	Title of papers	Credit	Internal marks	External marks	Total marks
cc-201	Statistics in physical education and sports	4	30	70	100
cc-202	Sports psychology	4	30	70	100
cc-203	Exercise physiology	4	30	70	100
cc-204	Elective course(any one) principal and organization of recreation/ professional preparation and curriculum design	4	30	70	100

Part –B Practical course

Pc-201	Athletics (jumping events)	4	30	70	100
Pc -202	Table tennis handball, cricket, boxing, judo (anyone out of these) sports theory, skills, techniques and officiating	4	30	70	100
	Total	24	180	420	600

M.P.E.S. Semester-IIIrd

Part A: Theoretical papers

Examination Evaluation

Course code	Title of papers	Credit	Internal marks	External marks	Total marks
cc-301	Bio -mechanics	4	30	70	100
cc-302	Sports management	4	30	70	100
cc-303	Test measurement and evaluation in physical education and sports	4	30	70	100
cc-304	Elective course(any one) physical fitness and wellness/ gender disability and inclusive sports education	4	30	70	100

Part –B Practical course

Pc-301	Athletics (throwing events)	4	30	70	100
Pc -302	Volleyball, wrestling, lawn tennis ,tae Kwando (anyone out of these sports theory, skills techniques and officiating	4	30	70	100
	Total	24	180	420	600

M.P.E.S. Semester-IV

Part A: Theoretical papers

Examination Evaluation

Course code	Title of papers	Credit	Internal marks	External marks	Total marks
cc-401	Scientific principal of sports training and coaching	4	30	70	100
cc-402	Sports medicine	4	30	70	100
cc-403	Yogic science and naturopathy	4	30	70	100
cc-404	Elective course(any one) philosophical foundation and history of physica education and sports dissertation	4	30	70	100

Part –B Practical course

Pc-401	Lesson plan of specialization	4	30	70	100
Pc-402	Classroom teaching	4	30	70	100
	Total	24	180	420	600

Semester - I

Paper – 1

Research Methods in Physical Education& Sports

Unit 1.

- Meaning, Definition, Nature, Importance and Scope of Research in Physical Education & Sports.

Unit 2.

- Meaning, Definition and Selection of Research Problem.
- Hypothesis and Review of Related literature, Library Techniques.

Unit 3.

- Sampling-Meaning, Definition, Types and importance.
- Sampling- Process and Techniques
- Research Tools-Questionnaire, Interview, Opinion ireetc.

Unit 4.

- Research Methods and Procedure.
- Historical Research-Meaning, Definition and Importance, Primary and Secondary Sources, External and Internal Criticism.
- Descriptive Research-Survey Studies(Meaning, Definition and Importance)
- Case Studies.
- Experimental Research- Meaning, Definition, Need and Experimental Designs and Laboratory Designs.

Unit 5.

- Research Proposal
- Research Report
- Preparation of a Research Report.

References:

1. Author's Guide: "Research Methods Applied to Health Physical Education and Recreation", Washington, D.C.,1991.
2. Best J.W., "Research in Education", Prentice Hall, New Delhi 1982.
3. Clarke H. David, "Research Processes in Physical Education, Recreation and Health", Prentice HallInc, Englewood Cliffs, New Jersey, 1985.
4. Kamlesh M.L., "Methodology of Research in Physical Education and Recreation", AHPER, Washington D.C., 1973.

Semester - I

Paper – 2

Health Education

Unit 1.

- Health-Guiding Principles of Health and Health Education.
- Health related fitness.
- Obesity and its Management.

Unit 2.

- Environmental and Professional Hazards and First Aid.
- Public Health and Epidemic Diseases-Symptoms, Treatment and Preventive Measures.
- Communicable Diseases-Symptoms, Treatment and Preventive Measures.

Unit 3.

- School Health Program and Personal Hygiene.

Unit 4.

- Theories and Principles of Recreation
- Recreation programs for various categories of people.

Unit 5.

- Population Education
- Causes for population explosion and its preventive steps.
- National family welfare scheme.
- Nutrition and Dietary manipulation.

References:

1. Greene, W.H., Simon-Morton, B.G.(1984). Introduction to Health Education. NY: Macmillan Publishing Company
2. Anspaugh, D.J., Ezell, G. (1995). Teaching today's health (4th Ed). Boston: Allyn & Bacon Park, K. (2007). Park's textbook of Preventive & social medicine (19th Ed). India: Varanasi das Bhanot Publishers.
3. Y.P. Bedi: Hand Book of Hygiene and Public Health.
4. Ma Curdy and Ma Grace : Muscular Exercise.
5. Peter V.Karpovich: Physiology of Muscular Activity.
6. Anatomy, Physiology, Kinesiology & Health Education : Dr. Ramesh Chand Kanwar

Semester - I

PAPER -3 Information Technology in Physical Education.

Unit 1.

Local Area Network and Internet

A. Networking

- Area and Classification
- Features and characteristics of LAN, Need of Network and its importance.
- LAN Topology-Ring, Star, Bus, Pitcher, Two Pitcher
- LAN, Survey, Work Station, Connection, Cable.

B. Internet

- Meaning, History, Application and Address.
- Introduction of Modem, Web client, Web Server.
- Dial up, Access, Direct Access.
- Introduction of Web browser, Use of Web browser (For Sports and Games)
- Introduction of Search engine, Uses, Objectives and types.
- Meaning and Definition of Firewall and Gateway.

C. Email

- Introduction, How to receive and send, how it works and Address book etc.

Unit 2.

Web Designing

- Introduction.
- Web browser and Programming.
- Program structure, Pair, Tag, Document, Head and Body Tag.
- Leaking Documents, Internal and External Documents.
- Heading Line, Drawing Line.
- Paragraph break- Font Styles (Bold, Italic and Underline)
- Types of Lists-Order and Unordered.

- Graphics, Images, Sound and Video.
- Tools, Header, Dia, Row, use of Caption Tag Width, Border, Working, Spacing, Bg Colour Column and Row. Spy Alignment (Column etc.)
- Form-Introduction, Design, Creation.
- Check box, Control Text box, Drop down, List box, Command and action button.

Unit 3.

- Multimedia and Presentation package.
- Fundamentals and application of multimedia.
- Tools of multimedia(Sports)
- Introduction of graphics, animation and morphing.
- Sound and Music

Unit :4

Presentation package

- Introduction, General Objectives, Tips on effective presentation, Opening, Creative presentation, Creative table, Making chart, Save and close, New slide, Slide change, Creation of black presentation, Changing font size, Working with graphic action button.

Unit 5.

Organizing various sports activities using Microsoft projects.

- Lab work : Introduction to sports software, Introduction to internet, Study of Email, Browsing sports activities on Internet, Preparing Slideshow on power-point, Preparing Slideshow on Multimedia, Teaching Multimedia package, Web Design.

References:

1. Irtegov, D. Operating System Fundamentals. Firewall Media.2004.
2. Milke, M Absolute Beginner's Guide to Computer Basics, Pearson Education Asia2007.
3. NIITBasicsofNetworkingPrentice–HallofIndiaPvt.Ltd,2004
4. Computers Today. Suresh K. Basandra, Galgotia publication, upgradededition-2008
5. Computers in Your Future, Marilyn Meyer & Roberta Baber,2nd edition, Prentice HallIndia
6. Computer Fundamentals. Pradeep K. Sinha & Priti Sinha, 4th edition, BPB Publication

SEMESTER I

Paper – 4.2

(Elective) Sports Journalism

Unit 1. Development of Journalism in India:

- Publication of newspapers in India
- Press, Literature, Renaissance.
- Group Mediums, Newspapers, Magazines, Television, Radio, Internet-Symptoms, Advantages and disadvantages.
- Importance of Sports Journalism.
- Language skill writing and Editing.
- Selection of Headers and Footers, Pictures, Layout, Design, Cartoon, Graphics, Graphs.

Unit 2. Qualities of Sports Journalist and Consolidation of news:

A. Qualities

- Knowledge of the game, Specialist in Sports.
- Research Attitude
- Individual Preparation and Cooperation.
- Specialization in Public Relations.
- Knowledge of the laws of the games.
- Urge for new knowledge.

B. Consolidation of News through,

- Individual sources,
- Commercial agencies,
- Newspaper listings,
- Meetings and seminars,
- Radio and television,
- Internet.

Unit 3. Difference between compilation of newspapers and magazines:

- Difference between newspapers and magazines
- Difference between writing styles
- Difference between presentations.
- Difference between selections of newspapers.
- Special skills.
- Selection of Pictures. Intro writing
- Intro writing of contemporary event or incident.
- Offhand comment on special occasions.

Unit 4. Sports administration and management:

- Level of Authorities: Different sports Associations, Universities, Colleges, schools etc.
- Level of Invitee/Non official: Association, Mandals, Clubs, Corporation, Social institutions, Society etc.

Unit 5. Welfare schemes:

- Awards to sportsmen: Arjun, Padmashree, Khelratna, Eklavya etc.
- Priority in Government jobs.
- Prizes and consolations for excellent performance.
- Benefit matches.
- Priority for additional marks for college admissions.

References:

1. Ahuja, B.N., Theory and Practice of Journalism, Surjeet Pub, Delhi, 1988.
2. Health Jr. Gelfand, How to Cover, Write and Edit Sports, Annes Lowa, USA, 1951.
3. Juris, John R., The Writing Games, Columbia Univ. Press, New York, 1969.
4. Nea. Robest, News Gathering and News Writing, Columbia HallInc, New York, 1949.
5. "Sports" by Bhola Singh Thakur (pp.111.1240) in the Indian Reporter Guide by Richard Richfield. Allied Pacific Pvt. Ltd., Bombay, 1962.
6. Woodward. S., Sports Page, Simon and Schuster, New York.1949.

Semester - I

Paper – 4.2

Sports Sociology (Elective)

Unit 1 Earning, Scope, Methods and Use.

A. Sociological Classification of Sports.

- Sociological concept and classification.
- Sports Research
- Concept and understanding of Sports.

Unit 2 Sports group and Administration:

A. Group Leadership, Constitution Methodology.

B. Administrative Leadership, Constitution ,Methodology.

Unit 3. Games and Social Institutions:

- Contribution of Family
- Educational Methods in Sports
- Contribution of socialization in sports.
- Socialization through sports

Unit 4. Sports and Social Status

- Sports Socialization and Limitations
- Sports related problems and Trends in Society.
- Sports and Aggression.
- Violence in sports.
- Commercialization in sports
- Women and Children in sports.

Unit 5. Sports and Micro Social System

- Study of Sports Groups
- Group Interaction, Competition and Co-operation
- Sports and Culture

REFERENCE:

1. Loy, John W., Kenyon, gerald S. & McPherson, Barry D. Sports Culture and Society (Philadelphia: Lea & Febiger, 1981).
2. Ball, Donald W. and Loy John W. Sport and social Order; Contribution to the sociology of sport, (London: Addison Wesley Publishing Co., Inc., 1975).
3. Loy John. W. McPherson, Barry D., and Kenyon Gerald, sport and Social System (London: Addison Wesley Publishing Company Inc.,1978).
4. Edward Larry. Sociology of sport (Illinois: The Dorsey Press,1973).
5. Cratty, Brayant J. Social Dimensions of Physical Activity New Jersey: Englewood Cliffs, Prentice Hall Inc., 1967.

Semester - II

Paper – 1

Statistics in Physical Education& Sports

Unit 1. Statistics: Meaning, Definition, Nature and Importance.

- Class Intervals: Raw Score, Continuous and Discrete Series, Class Distribution, Construction of Tables and Calculation.
- Graphical Presentation of Class Distribution, Histogram, Frequency Polygon, Frequency Curve. Cumulative Frequency Polygon, Ogive, Pie Diagram.
- Measures of Central Tendency: Mean Median and Mode- Meaning, Definition, Importance, Advantages and Disadvantages.
- Calculation of Mean and Median, Grouped and Ungrouped data, Raw Mode and calculation of mode from class intervals.

Unit 2. Measures of Variability

- Deviation, Percentiles and Quartiles-Meaning and Use.
- Calculation of Deviation Percentiles and Quartiles.
- Range, Quartile Deviation, Mean/Average Deviation, Standard Deviation-Meaning, Definition and use.
- Calculation of Quartile, Mean and Standard Deviation from Grouped and Ungrouped data.

Unit 3. Correlation:

- Meaning and Types.
- Calculation of Karl Pearson (Product Moment Method) and Spearman-Rank Order Correlation Method.

Unit 4. The Normal Curve:

- Meaning, Principles, Laws, Properties and Uses.
- Divergence from Normality-Skewness and Kurtosis.
- Scoring Scales- Sigma scale, Z Scale, T Scale.

Unit 5 : Reliability

- Meaning, Factors affecting Reliability.
- Randomization.

- Significance of difference between Means.
- T-test and F-test- Uses, Meaning.
- Calculation of T-test.
- Type I and Type II Errors.
- One Tailed and Two Tailed Tests.
- Null Hypothesis.

REFERENCE:

1. Best, john W. Research in Education, New Delhi Prentice Hall of India (P) Ltd. 1963.
2. Clarke David H. and Clarke H. Harrison, research Process in Physical Education, Recreation and Health, Englewood Cliffs, New Jersey Prentice Hall Inc.1979.
3. Clarke H. Harrison, the Application of Measurement in Healand Physical Education New York, Prentice Hall Inc.1979.
4. Good V. Caster and Scates Douglas E., Methods of research Application – Century, New York, 1954.
5. Mauly George J., The Science of Educational Research, New Delhi Eurasia Publishing Hours (P), 1963.
6. Robson M, Brar T.S. and Uppal A.K., Thesis format, Gwalior, LNCPE, 1979.
7. Bolnmera Paul and Lindquist, EF, Statistical Methods in Psychology and Education, Calcutta: Oxford Book Co.
8. Garret, Harry E and Good Worth R.S., Statistics Psychology and Education, Bombay Allied pacific Private Ltd.19.
9. Sukhia S.P., Mehrotra P.V. and Mefrotra R.N., Elements of Educational Research (Hindi), Agra Vinod Bood Publisher, 1984.
10. Guilford J.P., fundamental of Statistics in Psychology Educational, New York: McGraw Hill Book Cp. Inc.1956.

Semester - II

Paper – 6

Sports Psychology

Unit 1. Sports Psychology:

Meaning, Definition, Nature, Scope and Importance.

Unit 2. Process of Learning: Meaning, Definition, Principles, Laws and their implementation.

- Individual Differences: Meaning, Definition, Types and Reasons.
- Body Types: Sports Activity according to body types, Effect of Individual differences on skill acquisition and sports performance.

Unit 3.

- Emotion: Meaning, Definition, Types and Characteristics. Factors effecting Sports Achievement such as Stress, Fear, Frustration and Aggression.
- Motivation: Meaning, Definition, Types and Importance of Motivation in Sports Achievement.

Unit 4.

- Personality: Meaning, Definition and Principles.
- Dimensions of Personality, Views of Personality.
- Personality development through Physical Activities and Games.

Unit 5.

- Psychological Dimension of Competition-Psycho-Regulative Method for Excitement and Mental Relaxation.
- Effect of Audience on the performance of the Athletes.
- Psychological Preparation for competition-Short term and Long Term Preparation.

REFERENCE:

1. Alderman, R.B. *Psychological Behaviour in sports.* (Philadelphia: London, Sounders Company,1974).
2. But Susan Dorcas, *Psychology of Sports* (Network: Van Nastrand Reinhold Company) Edn.2.
3. Crattybrayant, J. *Movement Behaviour and Motor Learning***.** (Philadelphia: Lea and Febiger, 1973),Edn. 3.
4. Craty Bryant, J. *Psychology and Physical Activity.*(New Jersey Englewood Cleffs, Prentice Hall Inc.1965).
5. Cratty Bryant, J. *Psychological Proportion and Athletics Excellence.* (New York: Movement publications Inc.1978).
6. Gold Stcin and Joffery J. (Ed.) *Sports Games and play Social and psychological View points* (Lowerence Eribanm Associates, Publishers R.J. 1979).
7. Kamlesh M.L. *Psychology of physical Education and Sports.* (New Delhi: Metropolitan Book Co., Pvt.Ltd. 1983).
8. Kene J.E. *Psychological Aspect of Physical Education and sports.* (London, Boston: Rutledge and K. Egan Paul,1972).
9. Liewellyor Jack H. and Blucker Judy A. *Psychology of Coaching Theory and application* (Delhi: Surjeet Publishers, 1975).
10. Martens Rainer, *Social Psychology and physical Activity* (New York: Harper and Row Publishers, 1975).
11. Robert Glyn C. *Learning Experiences in sports Psychology***.** (Illinois: Human Kinetics Publisher Inc.1986).
12. Martens Rainer, *Coaching Guide to Sports Psychology* (Illinois: Human Kinetics Publisher Inc.1987).
13. Linda K. Binket, Robert J. Ratella and ann. S. Really. *Sports Psychology, Psychological consideration in* Maximizing Sports Performance (C. Brown publishers Dubugue Jawa).
14. Gill Dianel: *Ssychological dynamics of sports* (Illinois: Human Kinetics publisher Inc.1987).

Semester - II

Paper – 7

Exercise Physiology

Unit 1.

Exercise Physiology: Meaning, Definition, Importance and Scope.

Unit 2. Muscles, Types of Muscles and Types of muscular cells:

- Characteristics of Voluntary and Non voluntary Muscles.
- Design, Functions and Energy for Muscular Function
- Chemical Changes during muscular contraction.

Unit 3.

- Structure and functions of different systems of the body and effect of exercise on various systems. (Muscular System, Cardio-vascular System, Respiratory system, Nervous System and Digestive System)

Unit 4.

- Second Wind and Oxygen Debt.
- Warm up, Conditioning, Fatigue and (Prasham).
- Work Capacity under different environmental conditions.(Hot, Humid, Cold, High and Low Altitude)

Unit 5

- Sports and Nutrition.
- Concept of Balanced Diet.
- Pre Competition, During Competition and after competition diet of sportsman.
- Effect of smoking, Alcohol, Banned drugs on Sports Performance.

REFERENCE:

1. Guyton, Arthur C. Text Book of medical physiology. (Philadelphia: W.B. Saunder company, 1976).
2. Morehouse, L.E. and Miller, A.T. physiology of Exercise. (Saint Louis: The C. V. Mosby Company, 1976).
3. Karpovich, P.V. and Sinning, Wayne E. Physiology of muscular Activity (Philadelphia: W.B. Sauders Company, 1971). 7thEd.
4. Bourne, Geoffery H. The Structure and Function of Muscles: (London Academic Press1973).Astrand, P.O.and Rodahi. Karri. Text Book of work Physiology. (Tokyo McGraw Hill kogakusha, Ltd. 1979). Mathew, D.K.and Fox, E.L.Physiology Basis of Physical Education and Athletics (Philadelphia: W.B. Saunders Company, 1976).

Semester - II

Paper – 8.1

Principles and Organization of Recreation (Elective)

Unit 1. Concept of Recreation:

- Definition, Theory, Methodology and games.
- Concept of Recreation and Philosophy. Effect of Schools on different philosophies.
- Work, Relaxation and Recreation.
- Importance of recreation for Individual, Groups, Society, National and International brotherhood, Nature of Recreation activities.

Unit 2. History of Recreation:

- History of different activities and living styles of various civilizations, Momentum to different recreational activities, History of Vedic age, Epic age, Buddha age, Maurya age, British period, India after independence.
- Activities of villages and sources of recreation.

Unit 3.

- Planned momentum for recreational activities in India. Professor, C.D. Sondhi, Effect of Recreation on educational and industrial institutions, Y.M.C.A, Balkaan ji baati, Service and Ospel Club, Balabhavans, India Nation Association, National and International Associations.
- Comparative study of recreation-Agitation of Recreation in U.K, U.S.A, U.S.S.R, Japan, France and Germany and its effect on India.
- Recreational Schemes of State and National Government

Unit 4. Factors effecting Recreation

- Factors effecting population explosion, age, tribes and social status.
- Types of communities, urban, semi urban, rural, slums and business.
- Tools giving momentum to recreation and recreational institutions. Facilities for training.
- Effect of religions, tribes, knowledge and rituals.

Unit 5. Planning and Management.

- Survey of sources and needs.
- Preparing aims and objectives, managing programmes, managing funds.
- Place of training in recreational skills.
- Purchase, preservation and distribution of recreational tools.
- Establishment of evaluation methods.

References:

1. Dheer. S. & Radhika Kamal, Organization and Administration of Physical Education, Friends Publication, New Delhi – 1991.
2. Two Experienced Professors, Organization, Administration and Recreation in Physical Education, Parkash brothers, Educational Publishers, Ludhiana1986.
3. Butler G.O. introduction to "Community Recreation" Newyork Mc Graw-hill Co. Inc.1959 Dollar8.50.
4. H.D. Meyer and C.K. Bright bill community Recreation', A guide to its organization. NewZercy,1964.
5. "A Recreation". Professor Shri C.H. Dubey L.N.C.P.E. Gwalior.(M.P.)

Semester – II

Paper – 8.2

Professional Preparation and Curriculum Design (Elective)

Unit 1. Foundation of Professional Preparation:

- Ideals of Indian Democracy: Contribution of Physical Education.
- Forces and factors effecting educational policies- Social, Religious, Economical and political.
- Educational and professional preparation in physical education – Role of Central government.
- Professional Association. Professional Preparation in Physical Education:
- Historical review of professional preparation of Physical Education in India.
- Curriculum-Old and new concepts, Mechanics of curriculum planning.
- Basic principles of curriculum construction.

Unit 2. Under-graduate preparation of professional preparation

- Areas of Health education, Physical education and Recreation.
- Curriculum design-Experience of Education, Field and Laboratory.
- Teaching practice.
- Professional Competencies to be developed-Facilities and special resources for library, laboratory and other facilities.

Unit 3. Post-graduate preparation of professional preparation:

- Purpose of Post graduate studies.
- Area of specialization and concentration on core areas.
- Research requirements and methods of instructions.

Unit 4. Curriculum Design:

- Importance of curriculum design and effecting factors, Curriculum according to the needs of the students, national and professional policies.
- Role of teachers in curriculum design.
- Co-education and special programmes for women.

Unit 5.

- Selection of Teaching Method – Mass Education, Lecture, Project method and teaching aids.
- Time table for Physical Education and Sports activities in schools and classes.
- Supervision in Physical Education and Supervision methods.
- Recommendations for physical education curriculum by NCERT, CBSE, UGC, NCTE.

REFERENCE:

1. Brraw Harold M. Man and Movement: Principles of Physical Education, Philadelphia: Kea and febiger1983.
2. Bucher, Charles A. Foundation of Physical Education St. Louis: The C.Va Mosby & Company, 1986.
3. Cassidy, r. Curriculum Development in Physical Education, New York: Harper & Company, 1986.
4. Cowell, C.C. and Hazelton H.W. Curriculum Designs in Physical Education, Englewood Cliffs; N.J. Prentice Hall Inc. 1965.
5. Irwin: L.W. Curriculum in Health and Physical Education, Iowa: W.M.C. Brown Co.
6. Larson, L.A. Curriculum foundation in Physical Education, Englewood Cliffs; N.J. Prentice Hall Inc.
7. National Plan of Physical Education in Recreation, Ministry of Education, Govt. of India, 1956.
8. Pape. L.A. and Means, L.E.A. Professional Career in physical Education, Englewood, Cliffs, N.J. Prentice Hall, Inc.1952.
9. Reports of Various committees in Education and Physical Education and Physical Education, Govt. of India
10. Underwood, Gordon, L. The Physical Education Curriculum in Secondary School: Planning and Implementation England: Taylor and Francis Ltd. 1983.
11. Will goose, C.E. Curriculum in Physical Education 3rd Ed. Englewood Cliffs., N.J. Prentice Hall,Inc.1979

Semester - III

Paper –9

Bio-Mechanics

Unit 1.

- Biomechanics and Kinesiology: Meaning, Nature and Importance.
- Principles of plane and axis. Various types of movements.

Unit 2. Kinetics and Kinematics

- Motion: Linear motion, Rotary motion, Angular Motion, Curvilinear motion, Motion of transition.
- Balance, Newton's Laws of Motion, Acceleration, Velocity and speed.
- Force, Work, Power and Energy, Weight and Projectile.
- Leverage-Principles and Types.

Unit 3.

- Friction-Resistance, Water and Air Resistance.
- Elasticity.
- Spin
- Centrifugal and centripetal force.

Unit 4.

- Mechanical Analysis of Motor Movements-Walking, Jumping, Running, Throwing, Catching,Holding, Climbing, Lifting, Swinging, Gliding, Pulling.

Unit 5. Mechanical Analysis of Sports Skills

- Athletics(Running, Jumping, Throwing)
- Swimming.
- Football.
- Basketball
- Volleyball.
- Cricket.

REFERENCE:

1. Bunn, Hohn W. Scientific Principles of Coaching (Englewood Cliffs, N.J.: Prentice Hall Inc.,1972).
2. Simonian Charles, Fundamentals of Sport Biomechanics (Englewood Cliffs, n.J.: Prentice Hall Inc.,1911).
3. Hay, James, G. The Biomechanics of Sports Techniques. (Englewood Cliffs, N.J.: Prentice Hall, Inc.,1970).
4. Broer, M. Roin R.and Zernicke, R. Ronald F.Efficiency of Human Movement

   (Philadelphia: W.E. Saunder Co., 1979).
5. Hay, James G. and Reid J. Gavind, The Anatomical and Mechanical Basis of Human Motion(EnglewoodCliffs,N.J.:prenticeHallInc.,1982).
6. Hay, James G. and Reid J. Gavind, Hay, Anatomy, Mechanics and human Motion(EnglewoodCliffs,N.J.:prenticeHallInc.,1988).

Semester - III

Paper – 10

Sports Management

Unit 1.

- Sports Management-Meaning, Definition, Importance, Principles and functions.

Unit 2. Administration-Meaning, Types.

- Administration of education department and its functions.
    a. School Games Federation of India.
    b. State Education Sports Wing-School Administration.
    c. Association of Indian Universities.
    d. University department of Physical Education.
    e. College Physical Education Department, Administration of non teaching department and its functions.
    f. Youth and Sports department
    g. SAI
    h. Indian Olympic Association, Indian Sports Associations.
    i. State Sports Department

Unit 3. Administration of Sports Facilities, Equipment's, Funds and Employees.

- Facilities: Administration, Types, Need, Purchase of Equipment's, Preparation of fields and maintenance, Indoor Facilities (Gym, Swimming pool).
- Equipment's: Importance, Types, Purchase, Maintenance, Stock maintenance and disposal.
- Funds: Objective of Budget, Principles of budget preparation, ideal budget, its uses.
- Employees Administration: Leadership, Principles ,Need, Teacher's training improvement program.

Unit 4. Planning and supervision in Physical Education.

- Principles of Lesson planning.
- Supervision-Definition, Nature, Scope, Principles, Duties of a supervisor, Qualities of a supervisor, Method and effective supervision.

Unit 5. Public Relations

- Definition, Objectives and Need.
- Principles
- Planning and administration of program of public relations.
- Mediums and agencies.
- Steps for effective and qualitative public relations.

REFERENCES:

1. Earl F. Zeigh & Gary W. Bowie. Management Competency Development in Sports and Physical Education., (Philadelphia: W. Lea and Febiger,1963).
2. Joseph Bucher and Earnest Kienige burg, Scientific Inventory Management (New Delhi: Prentice Hall of India Pvt. Ltd.,1968).
3. Ashton D. Administration of Physical Education for Women (NewYork:The Ronal Press Cl,1968).
4. Bucher C.A. Administrate on of Physical Education and Athletic Program(St. Louis: The C.V. Mosby Co., 1979),7th Edition.
5. Daughtrey G. and Woods J.B. physical Education and Intramural Programs, Organization and Administration (Philadelphia U.S.A. : W.B. Sounders Cp., 1976), 11thEd.
6. Ferry the C.E. and Duncan R.C. Administration of Physical Education (New York: Prentice Hall Inc.1951).

Semester - III

Paper – 11

Test, Measurement and Evaluation in Physical Education & Sports

Unit 1.

- Test, Measurement and Evaluation-Meaning, Definition and Importance. Modern Trends in Measurement and Evaluation.
- Test Evaluation-Criteria of Test Selection, Objectivity, Reliability, Norms of Validity.

a. Classification of tests-Standardized tests, Teacher made tests, Subjective and objective tests.

b. Construction of knowledge and skill tests.

c. Steps in construction of knowledge and skill tests.

Unit 2.

A. Physical Fitness and Motor Fitness Tests.

- AAHPER Youth Fitness Test.
- National Physical Fitness Test.
- Indiana Motor Fitness Test.
- Philip's JCR Test.

B. Common Motor Strength Tests.

- Baroni –Common Motor Strength test.
- Newton Motor Strength test.
- Cozen's athletic ability test.
- Mc.Cloy's General motor ability test.

C. Cardio vascular and Respiratory Tests.

- Harvard Step Test.
- Cooper's 12 min continuous run/walk test.
- Kraus-Weber strength test.
- Roger strength test.

Unit 3. Sports Skill tests: Need and Use.

- Badminton- Lockhart and McPherson Badminton skill test, Miller wall Volley test.
- Basketball-Johnson Basketball skill test, Beach Basketball skill test.

- Hockey-Harvan singh Hockey Test.
- Tennis- Dyer Tennis skill test, Hewitt Tennis skill test.
- Volleyball-Russell Lange test, Brady Volleyball Skill Test.
- Football-Mcdonald Football skill test, SAI Football skill test.

Unit 4. Socio and Psychological Tests.

- Mc.Cloys behavior rating scale.
- Cowell social behavior trend index.
- Peterson's Social capacity test.
- Swakhyal test.

Unit 5.

Anthropometric measurements.

- Equipments.
- Body Fat measurement, General body measurements.
- Body composition measurements.

References:

1. ACSM's Health / Fitness Facility Standards and Guidelines, New York: HumanKinetics,1992.
2. Barrow, Harold M. and McGhee, "Rosemary, A Practical Approach to Management inPhysical Education" Pniladelphia: Lea and Febiger 1979.
3. Clake, H. Harrison.: Application of Measurement to Health and Physical Education, New Jersey: Prentice Hall Inc.1976.
4. Edmund O. Acevedo and Michael A. Starks, Exercise Testing and Prescription labManual, USA: Human Kinetics Publishers,2003.
5. Safrit, Margaret J.: Introduction to Measurement in Physical Education and Exercise Science,St. Louis: Mosby,1995.

Semester - III

Paper – 12.1

Physical Fitness and Wellness. (Elective)

Unit 1. Meaning & Definition of Physical Fitness, Importance & Advantage of Physical Fitness.

- Concept of Fitness
- Health Related Fitness
- Skill Related Fitness

Unit 2.

- Principles of Exercises.
- Model Program
- Importance of gymnasium and health-clubs.
- Exercise guidance program for Children, youth and special age groups.
- Construction of appropriate exercise program.

Unit 3. Physical Fitness activities:

- Aerobics
- Water exercises.
- Neurological training.
- Agility and equilibrium training.
- Isometric training.
- Cycling.
- Ladder climbing.
- Treadmill.
- Walking
- Health advantages.

Unit 4.

- Planning for lifelong fitness program, Aims of fitness, Encouragement for health and prevention of diseases, Domestic exercise equipment's, Fitness program for handicapped and mentally retarded children, Exercise for adults.
- Management in physical fitness and stress, Concept of stress, Effect of exercises in stress

management, Time management.

Unit 5. Meaning and Definition of Wellness

- Components of Wellness
- Contribution of Behavior in Wellness
- Advantage of Wellness

References:

1. Anderson, B., Stretch Yourself for Health & Fitness, Delhi : UBSPD,2002.
2. Austin and Noble, Swimming For Fitness, Madras: All India Pub.,1997.
3. Bean,Anita,FoodForFitness,London:A&CBlock,1999.
4. Callno Flood, D.K., Practical Math For Health Fitness, New Delhi,1996.
5. Cox, Corbin, C.B &Indsey, R., Concepts of Physical Fitness, WC Brown,1994.
6. Difiore, Judy, Complete Guide to Postnatal Fitness, London : A & C Black,1998.
7. Giam, C.K & The, K.C., Sport Medicine Exercise and Fitness, Singapore: P.G. Medical Book, 1994.
8. Gosselior, C., The Ultimate Guide to Fitness, London: Vermilion,1995.
9. Harrison, J.C., Hooked on Fitness, NY: Parker Pub. Com.,1993.
10. Hoeger, W.K. and S.A., Principles and Labs for Physical Fitness, Englewood Morton,1999.
11. Kirtani, Reema, Physical Fitness, Delhi : Khel Sahitya,1998.
12. Maud, J.R. and Foster, C., Physiology Assessment of Human Fitness, New Delhi,
13. Mcglynn, G., Dynamics of Fitness, Madison : W.C.B Brown,1993.
14. Muller, J. P., Health, Exercise and Fitness Delhi : Sports,2000.
15. Muller, J.P., Health Exercise and Fitness, Delhi: Sports,2003.
16. Saggar, S.K., Physical Fitness, New Delhi :Rupa Co.,1994.
17. Sharkey, B.J., Physiology of Fitness, Human Kinetics Book,1990.
18. Thani, Lokesh, Rules of Games and Games and Fitness, Delhi: Sports,2003.

Semester - III

Paper – 12.2 (Elective)

Gender, Disability & Inclusive Sport Education

Unit 1

- Defining Gender and features of gender inequality
- Gender inequality in Education in India
- Gender based violence as a development and rights challenge

Unit 2

- Historical roots of gender construction in India –patriarchy and its socio- cultural origins
- Impact of gender as a social construct.
- Gender roles and the female stereotype in India
- The Global Gender Equality Agenda

Unit 3

- Gender issues in access to education & physical education
- Quality of work and equal opportunity
- Gender in the physical education classroom and peer interactions
- Gender issues in participation in sports

Unit 4

- Constitutional provisions for education of women in India
- UEE and programs for education of women in India
- Gender and policy perspective
- Class and Inequality

Unit 5

- Definition, concept and importance of inclusive education.
- Historical perspectives on education of children with diverse needs.
- Difference between special education, integrated education and inclusive education.
- Advantages of inclusive sports education for all children.

- Educational approaches and measures for meeting the diverse needs
- Building inclusive learning friendly sports facilities, overcoming barriers for inclusion.
- Creating and sustaining inclusive practices.
- Role of teachers, parents and other community members for supporting inclusion of children with diverse needs for participation in sports.

References:

1. Chanana Karuna (ed) Socialization, Education and Women, Orient Longman, New Delhi,1988
2. Mandell, Nancy (ed), Feminist Issues: Race, Class and Sexuality, Prentice Hall, Ontario, 1995
3. Nambissan, Geeta B, Gender and Education: The Social Context of schooling Girl Children in India, 1995.
4. Erik Olin Wright, "From Paradigm Battles to Pragmatist Realism: toward saninte grated class analysis", New Left Review (forthcoming)
5. Daryl Glaser, "Class as a Normative Category: Egalitarian Reasons to Take It Seriously (With a South African Case Study)
6. Daryl Glaser, 'Should An Egalitarian Support Black Economic Empowerment?', Politikon, vol. 34,no. 2, 105-123,2007.
7. John Roemer paper: "Should Marxist's care about exploitation" in Analytical Marxism and Philosophy & public affairs1985
8. Michael Marmot, Richard Wilkinson, Social Determinants of Health: The Solid Facts
9. Mel Kohn, Class and Conformity, excerpts
10. Mel Kohn and Carmi Scholar, Work and Personality, excerpts 11.Gomberg, How to make opportunity equal (Blackwell,2007)
12. Ainscow, M., Booth. T (2003): The Index for Inclusion: Developing Learning and Participation in Schools. Bristol: Center for Studies in Inclusive Education.
13. Ahuja. A, Jangira, N.K. (2002): Effective Teacher Training; Cooperative Learning Based Approach: National Publishing house 23 Dareyaganj, New Delhi110002.
14. Jangira N.K. and Mani, M.N.G. (1990): Integrated Education for Visually Handicapped, Gurgaon, Old Subji mandi, Academic Press.
15. Jha. M.(2002) Inclusive Education for All: Schools Without Walls, Heinemann Educational publishers, Multivista Global Ltd, Chennai, 600042,India.
16. Sharma, P.L. (1990) Teachers handbook on IED-Helping children with special needs N. C. E RT Publication.
17. Sharma P.L (2003) Planning Inclusive Education in Small Schools, R.I E. Mysore

Semester - IV
Paper – 13

Scientific Principles of Sports Training and Coaching

Unit 1. Sports Training:

- Definition and meaning of Sports Training and Coaching.
- Aims and objectives.
- Characteristics.
- Principles.

Unit 2. Training Load:

- Factors.
- Principles.
- Overload-Meaning, Reasons, Characteristics, Remedies to overcome overload.
- Adaptation Procedure-Meaning, Stages of Adaptation process.

Unit 3. Training of Motor Components:

- Strength-Meaning, Types, Characteristics, Principles of strength of training, Methods of strength training, Strength training for women and children.
- Endurance-Meaning, Types, Characteristics, Methods of Endurance training.
- Speed- Meaning, Types, Characteristics, Methods of speed training.
- Flexibility- Meaning, Types, Characteristics, Methods of flexibility training.
- Coordination- Meaning, Characteristics, Classification, Importance, Training methods of coordinative abilities.

Unit 4.

- Techniques- Meaning, Techniques of different games, Importance of training, Factors

Unit 5. Effects on training process, Correction of faults-Skill, Style and Technique.

- Tactics-Meaning, Aims, Training, Principles of preparation of tactics, Difference between tactics and strategy.

Planning of Training and Competition:

- Planning of Training- Meaning, Importance, Principles and Types.
- Periodization-Meaning, High Performance and Per iodization, Period and Types.
- Competition-Meaning, Importance, Scope, Methods, Frequency, Preparation of Competition.

REFERENCE:

1. Harre, Dietrich, Principles of Sports Training (Berlin:Sporulated,1982).
2. Dick W. Frank. sports Training Principles (London: Lepus Books,1980).
3. Jensen, R. Clayne, and Fisher A.G. Scientific Basis of Athletic conditioning (Philadelphia: Lea and Fibiger 1979), 2nd Edn.
4. Matvyew, L.P. Fundamental of sports Training (Moscow: Progress Publishers,1981).
5. Cratty, J. Brayant Perceptual and Motor Development in Infants and Children (N.J.: Englewood Cliffs, Prentice Hall, Inc.1979).
6. Singh, H. Sports Training, General Theory and methods (Partials: NSNIS,1984).
7. Bunn, J.W. : Scientific Principles of Coaching.
8. Morehouse and Rash : Scientific Basis of Athletic-Training.

Semester - IV

Paper – 14

Sports Medicine

Unit 1. Effecting training, Stages of Training

- Sports Medicine: Meaning, Definition, Aims, Objectives, Modern Concepts and Importance.
- Athletes Care and Rehabilitation: Contribution of Physical Education Teachers and Coaches.

Unit 2. Sports Injuries and Remedies:

- Injuries:
  a. General Injuries: Wound, Lesion, Contusion, Burn, Abrasion, Sprain, Strain, Fracture.
  b. Special Injuries: Injuries on Back, Abdomen, Thigh, Knee, Ankle, Feet, Legs.
- Reasons for Injuries, Preventive measures for injuries, Treatment for Rehabilitation.

Unit 3. Massage and various therapies:

- Hydrotherapy: Contrast Bath, Sauna bath, Water Massage, Whirlpool.
- Cryotherapy: Ice pack, Gel and chemical cold Pack, Ice Massage, melting ice cry therapy.
- Electrotherapy: Shortwave diathermy, Ultrasound, Electric moist heating pad, stimulant, Infrared, Ultraviolet electric waves.
- Exercise Therapy: Isotonic, Isometric, Is kinetic Exercise training.
- Massage: Meaning, Importance, need and Types.

Unit 4. Nutritional diet for athletes and drugs:

- Athlete Nutritional Diet – Factors effecting balance diet, Athlete's Diet for different sports and games, Malnutrition in athletes and it scare.
- Doping – Meaning, History, Definition, Classification, Types, Use of drugs and their side effects, Role of Coach and Managers in solving the problem of doping.

Unit 5. Women Athlete:

- Anatomical and Physiological differences.
- Health Problems: Menses, Pregnancy, Special problems.

References:

1. Ann. Lowlin. Women's Fitness Program Development Human, Kinetics.2002.
2. Bengt O. Eriksson et al, Sports Medicine, GuinnesPublication,1990.
3. Christine M. Drews, Physiology of Sports and Exercise, Human Kinetics, USA,1999.
4. David R. Mottran, Drugs in Sports (4th Ed) Routledge Taylor and Francis Group,2005.
5. Erikson, B.O. et al, Sports Medicine, Guiness Pub. Great Britain, 1990.
6. Jain, Rachna, Sports Medicine, KSK, New Delhi,2002.
7. Jeyaprakash, C. S., Sports Medicine, J.P. Brothers Pub., New Delhi,2003.
8. Khanna, G.L., Exercise Physiology & Sports Medicine, Lucky Enterprises, Delhi,1990.
9. Mathew D.K. & Fox E.L, Physiological Basis of Physical Education and Athletics, W.B. Saunders Co: Philadelphia,1971.
10. Pandey, P.K., Outline of Sports Medicine, J.P. Brothers Pub., New Delhi,1987.
11. Pandey, P.K.,Sports Medicine, Khel Sahitya Kendra, NewDelhi,1998.

Semester - IV
Paper – 15

Yogic Science and Naturopathy

Unit 1.

- Yoga-Meaning and Importance, Paths, Precautions, Difference between exercises and Yoga, Types of Asanas and Surya namaskara.
- Ashtang Yoga- Different types of Pranayama and its importance, Kriyas, Bandhas and Mudra sciences-Nadis: Chandranadi, Surya nadi and Agninadi.

Unit 2.

- Place of Shodhan karma in Yoga, Nature of Mechanical Shodhan karma and Classification.
- Different glands in yoga, effect of yoga on different systems, plexis, Kundlini, Scientific observations of Yogasana.

Unit 3.

- Yoga Philosophy, Philosophy of Sankhya yoga, Yoga Psychology, Yoga science of Vibhuti, Prana science of Yoga.
- Panchprana-Upprana and factors deciding pranayama.
- Asanas and Pranayama for therapy of various diseases, Inculcating spiritual values through pranayam.

Unit 4.

- Naturopathy-Meaning, History, Importance and Agencies.
- Principles of Naturopathy

Unit 5.

- Difference therapies done through Naturopathy.
- Shivambu method, Acupressure and Acupuncture methods, Magnetic therapy.

References:

1. Swami Kuvalayananda and S.L. Vinekar -Yogic Theraphy.
2. Asanas–Swami Kuvalayananda. Kaivalyadha, a, Lonavla.
3. Swami Kuvalayananda, Kaivalyadhama, Lonavla -Pranayama.
4. K. Chandrasekar - Sound Health Through Yoga by Prem KalyanPublications, Sedapatti, 1999.
5. Teaching Methods for – M.L. Gharote and Yogic Practive S.K. Ganguly, Kaivalyadhama, LonavlaM.L. Gharote- Applied Yoga–Kaivalyadhama, Lonavla.
6. Yogasanas :A Teacher's Guide– NCERT, New Delhi.
7. O.P. Tiwari- Asanas–Why? And How? – Kaivalyadhama, Lonvla.
8. R. Thirumalaisamy (1987) – Yoga for Good Health, Karaikudi Senthil Kumar publishers.

Semester - IV

Paper – 16.2 (Elective)

Philosophical Foundation and History of Physical Education& Sports

OR

Dissertation

Unit 1.

- Education
- Meaning, Definition, Aims and Objectives of Education.
- Meaning, Definition, Aim and Objectives of Physical Education and Relationship of Physical Education with General Education.
- Physical Education and Philosophy.

Unit 2.

- Psychological Basis of Physical Education
- Play and Theories of Play
- General Principles of Growth and Development
- Principles of Motor skill acquisition

Unit 3.

- Philosophies of Education as applied to Physical Education-Idealism, Naturalism, Realism, Pragmatism, Existentialism and Humanism.

Unit 4.

- Sociological Basis of Physical Education
- Socialization Process
- Social Nature of Man and Physical Activities, Sports as cultural heritage of mankind.
- Customs, traditions and Sports.

Unit 5.

- Physical Education in Ancient Greece, Rome, Germany, Sweden, Denmark, and Russia.
- Physical Education in India.
- Olympic Movement – Historical Development of Ancient and Modern Olympics.

References:

1. Jay Coackley Sports in Society: Issue & controversies (2007) McGraw Hill, New York
2. Shamshad Ahmed. Education in Physical Education Books (2005). Isha. New Delhi.
3. Syal, Meenu. Physical Education Sports and Games. Sports Publication, (2005). New Delhi
4. Davis, M. B.Physical Training in School. Sports Publication, (2004). New Delhi.
5. Shekar, C. K. Foundation of Physical Education and Sports. Khel Sahitya Kendra, (2004).New Delhi.
6. Jain, Anoop. Physical Education Foundation. Sports Publication, (2003). New Delhi.
7. Wuest, Deborah A. Foundation of Physical Education, Exercise Science and sports. McGraw Hill,(2003). New York.
8. Jain, D. Physical Education for Secondary School Children. Khel Sahitya Kendra,(2003). NewDelhi.

Choice Based Credit System (CBCS)
Department of Microbiology,
School of Life Sciences,
Dr. B. R. Ambedkar University, Agra

M.Sc. Microbiology I semester

Core Courses	Course Title	Marks		Total 100	Credit
		CIE	End Semester Examination		
MB -C101	Mycology	25	75	100	4
MB -C102	Virology	25	75	100	4
MB-C103	Bacteriology	25	75	100	4
MB-C104	Microbial Biochemistry and Basic Enzymology	25	75	100	4
MB-105	Practical		100	100	4
	Industrial training/Survey/Research Project				
	Total			**500**	**20**

II semester

Core Courses	Course Title	Marks		Total	Credit
		CIE	End Semester Examination		
MB-C201	Molecular Biology	25	75	100	4
MB -C202	Microbial Genetics	25	75	100	4
MB-C203	Bioinstrumentation	25	75	100	4
MB-C204	Immunology	25	75	100	4
MB-205	Practical		100	100	4
MB-206	**Industrial training/Survey/Research Project**		200	**200**	**8**
	Minor	25	75	**100**	**4**
	Total			**800**	**32**

III semester

Core Courses	Course Title	Marks		Total	Credit
		CIE	End Semester Examination		
MB-C301	Microbial Metabolism	25	75	100	4
MB-C302	Biostatics and Computer Application	25	75	100	4
MB-C303	r DNA technology	25	75	100	4
MB-E304	Computational biology	25	75	100	4
MB-E305	Microbial Genomics and Proteomics				
MB-306	Practical		100	100	4
	Industrial training/Survey/Research Project				
	Total			**500**	**20**

IV semester

Core Courses	Course Title	Marks		Total	Credit
		CIE	End Semester Examination		
MB-C 401	Medical Microbiology	25	75	100	4
MB-C402	Industrial Microbiology	25	75	100	4
MB -E403	Food and dairy Microbiology	25	75	100	4
MBE-404	Environmental Microbiology				
MB 405	Agricultural Microbiology	25	75	100	4
MB-E406	Plant Pathology				
MB- 405	**Practical**		100	**100**	**4**
MB-406	**Industrial training/Survey/Research Project**		200	**200**	**8**
	Total			**700**	**28**

Note:

1. Total number of credits in M.Sc. (Microbiology) I year/ B.Sc. research is 52 credits.
2. Total number of credits in M.Sc. (Microbiology) II year 48 credits.
3. Total credis required for M.Sc. (Microbiology will be 52=48 = 100
4. SKILL, ENTEPEUNERSHIP, EMPLOYABILTY

Programme Outcomes (PO)

On completing Masters in Microbiology, the students shall be able to realize the following outcomes:

PO1: Understand the basic concepts, fundamental principles, and the scientific theories related to various scientific phenomena and their relevance in day-to-day life.

PO2: Acquire the skills in planning and performing and handling scientific instruments during laboratory experiments

PO3: Able to think creatively (divergently and convergent) to propose novel ideas in explaining facts and figures or providing new solutions to the problems.

PO4: Learn how an interdisciplinary approach helps in providing better solutions and new ideas for sustainable development.

PO5: Understand the knowledge of subjects in other faculties that can greatly and effectively influence the evolving new scientific theories and inventions.

PO6: Imbibe ethical, moral and social values in personal and social life

PO7: Develop various communication skills which we will help in expressing ideas and views clearly and effectively.

PO 8: Ability to think logically and creatively, and to solve scientific problems

PO 9: Equipped to take up a suitable position in academia or industry or Institutions and to pursue a career in research.

Programme Specific Outcomes (PSO)

On completing M.Sc. Microbiology Programme, the students shall be able to realise following outcomes:

PSO 1: Shall be able to design and execute experiments related to Basic Microbiology, Molecular Biology, Immunology, Recombinant DNA Technology, Biochemistry, Environment, Agriculture, Medical, Industrial, Food Microbiology.

PSO 2: Shall be able to perform minor research projects incorporating techniques of Basic and Advanced Microbiology. The learners will be equipped to take up a suitable position in academia or industry or Institutions and to pursue a career in research if so desired.

PSO 3: Shall be able to compete in national level competitive exams such as NET-JRF or GATE or International exams and can pursue career in higher studies

PSO 4: Shall practice safe microbiology, using appropriate protective, biosafety and emergency procedures.

PSO 5: Shall have in-depth theoretical and practical knowledge of huge diversity of microorganisms, their metabolism & physiology, concepts of molecular genetics and genetic engineering, biosynthetic pathways, enzymology, microbial pathogenicity, role of microbes in food, agriculture and environment, health and disease.

PSO 6: Shall be able to apply the scientific method and hypothesis testing in the design and execution of experiments including the understanding of theoretical background, hypothesis generation, collection and analysis of data, and interpretation and presentation of results.

PSO 7: Shall be able to communicate scientific results to the general public and experts by writing well-structured reports and contributions for scientific publications and posters, and by oral presentations.

M.SC. MICROBIOLOGY I SEMESTER
CORE COURSE
MB-C101 MYCOLOGY
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

Course Objectives: The objective of this course is to provide a detailed overview Status of fungi in living world, Fungal Diversity of major taxonomic groups, Life cycle and sexual process in fungi and fungal metabolites.

Course Level Learning Outcomes: Upon successful completion of the course, the learner will be able to –

CO1: Student will have basic knowledge of status, classification, phylogeny of fungi and their role in biotechnology

CO2: Student will have specific knowledge of fungi belonging to various taxonomic groups: Gymnomycota, Mastigomycotina, Amastigomycotina

CO3: Student will have specific knowledge of fungi belonging to various taxonomic groups: Ascomycotina, Basidiomycotina, Deuteromycotina

CO4: Students will be acquainted with Life cycle and sexual process in fungi, Genetic variation in fungi and fungal metabolites

	PO1	PO2	PO 3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	-	-	1	1	-	-	-	3	1	1	1	-	2	-	1
CO2	-	-	-	-	1	-	-	-	-	-	-	-	-	1	-	-
CO3	-	-	-	-	1	-	-	-	-	-	-	-	-	1	-	-
CO4	3	-	-	1	1	-	-	1	1	1	1	1	-	3	2	1

M.SC MICROBIOLOGY I SEMESTER
CORE COURSE
MB-C101 MYCOLOGY
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

TOPIC	TEACHING HOURS
UNIT –I Status of fungi in living world, general features of fungi and fungus like organisms, recent trends in the classification of fungi, physiology and growth of fungi, nutritional and environmental factors affecting growth, saprotrophs, parasites of Mutualistic symbionts, physiology of reproduction in fungi, Phylogeny of fungi. **Fungi and Biotechnology** Production of alcoholoic beverages, antibiotics, organic acids, ergot alkaloids, the cultivation of fungi for food- Mushrooms, mycofoods, Role of fungi in agriculture and forestry- Mycorrhizae and their application,	**15**
UNIT-II **Fungal Diversity- major taxonomic groups, structure, reproduction, life cycle and significance of the following representative:** 1. Gymnomycota- Cellular slime moulds (Dictyostelium), Plasmodial slime moulds (myxomycetes) 2. Mastigomycotina- *Coelomomyces*, *Lagenidium*, *Achlya*, *Phytophthora*, *Peronospora*, *Plasmodiophora* **3.** Amastigomycotina- Zygomycotina, *Mucor*, *Syncephalastrum*, *Blakeslea*, *Cunninghamella*, *Entomorphthora*.	**15**
UNIT- III **Fungal diversity contd.** 1. Ascomycotina- *Taphrina*, *Chaetomium*, *Morchella*, *Neurospora* 2. Basidiomycotina- *Puccinia*, *Melampsora*, *Polyporus*, *Lycoperdon* **3.** Deuteromycotina- *Fusarium*, *Cercospora*, *Curvularia*, *Beauveria*, *Microsporum*	**15**
UNIT- IV 1. Life cycle and sexual process in fungi, 2. Genetic variation in fungi- Nonsexual variations- haploidy, heterokaryosis, parasexuality, sexual variations, homothallisum and heterothallium, Mutation, physiological specialization. 3. Mycopesticides **4.** Mycotoxins.	**15**

Suggested Books:

1. Introductory Mycology, CJ Alexopoulos, CW Mims, M Blackwel, JohnWiley& Sons.
2. The Fungi: An Advanced Treatise, GC Ainsworth, KF Sparrow, AS Sussman.
3. An Introduction to Fungi, HC Dube, VikasPubl, New Delhi.
4. The Fungi, PD Sharma, Rastogi Publications, Meerut
5. Fungi: Experimental Methods in Biology, R Maheshwari, CRC Press, Boka Raton, Florida
6. Introduction to Fungi, J Webster & WS Roland, Cambridge University Press.
7. A Text Book of Modern Plant Pathology, KS Bilgrami, HC Dube.
8. Plant Pathology, RS Mehrotra.
9. Fungi and Plant Disease, VK Gupta, TS Paul
10. Diseases of Crop Plants in India, Rangaswamy&Mahadevan.
11. Plant Pathology, GN Agrio Elsevier Academic Press.
12. Molecular Plant Pathology, Dickinson CM, Bios Scientific Publisher
13. Plant Pathology: Concepts and Laboratory Exercises, NT Robert, MT Windham, ASWindham, CRC Press.
14. Principles of Plant Pathology, RS Sing, Oxford and IBH Publishing Co. Pvt Ltd.

M.SC MICROBIOLOGY I SEMESTER
CORE COURSE
MB-C102VIROLOGY
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

Course Objectives: The objectives of this course are to provide basic understanding of the nature of human and plant viruses (including phages), viral classification, cultivation of viruses and viral diseases.

Course Level Learning Outcomes: Upon successful completion of the course, students will have the knowledge and skills to

CO1: Explain the key concepts in virology having knowledge of Classification, Morphology and Chemistry of Viruses

CO2: The students will know about various Virus replication Strategies

CO3: Students will be able to define and explain Subviral pathogens, Pathogenesis of viral infection and Anti-viral strategies-prevention and control of viral diseases

CO4: Students will be acquainted with History and development of plant virology, cryptograms, and classification of plant viruses and viroids and have knowledge of Symptoms of plant virus diseases, transmission of plant viruses, viral and viroid diseases and their

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	1	1	-	2	-	-	1	2	2	2	2	1	2	-	2
CO2	3	-	-	-	2	-	-	-	1	-	1	2	-	-	-	1
CO3	3	-	-	-	2	-	-	-	1	-	1	3	-	-	-	1
CO4	2	-	-	-	2	-	-	-	1	-	1	3	-	-	-	1

M.SC MICROBIOLOGY I SEMESTER
CORE COURSE
MB-C102VIROLOGY
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

TOPIC	TEACHING HOURS
Unit I: **Classification, Morphology and Chemistry of Viruses:** Virus evolution and classification, properties of viruses, virus structure, Techniques for visualization and enumeration of viral particles, measuring biological activity of viruses, assays for virus estimation and manipulation, characterization of viral products expressed in infected cells.	**15**
Unit II **Virus replication Strategies:** Principal events involved in replication: Adsorption, penetration, uncoating nucleic acid and protein synthesis, intracellular trafficking, assembly, maturation and release, viral-host interaction, Host response to viral infection. Identification of virus prototypes associated with different virus replication schemes; Details on important viruses namely Herpesvirus, Poliovirus, Influenza virus, Adeno Virus, Poxviruses, Hepatitis Viruses, coronaviruses, Retroviruses.	**15**
Unit III **Subviral pathogens:** HDV, Prions, Viroids **Pathogenesis of viral infection:** Stages of infection, Patterns of some viral diseases-epidemiology, transmission, infection, symptoms, risk, transformation and oncogenesis, emerging viruses. **Anti-viral strategies-prevention and control of viral diseases:** Host specific and nonspecific defense mechanisms involved in resistance to and recovery from virus infections. Role of interferon in viral infections. Contributions of various host defense mechanisms in viral infections; History of vaccines especially smallpox and polio. New methods: subunit vaccines,anti-idiotype and DNA vaccines.	**15**
Unit IV **History and development of plant virology, cryptograms, and classification of plant viruses and viroids:** Brief history of virology highlighting the significant contributions of scientists to the development of plant virology; significance of plant virology and modern classification of plant viruses and viroids according to ICTV; and cryptograms of various plant viruses and virus groups **Symptoms of plant virus diseases, transmission of plant viruses, viral and viroid diseases and their control:** General discussion on symptoms caused by viruses and viroids in diseased economically important trees and agricultural crops, and their control including development of virus disease resistant transgenetics	**15**

Suggested Books:

1. Medical Virology 10 Th Edition by Morag C and Tim bury M C .ChurchilLivingstone, London.
2. Introduction to Modern Virology 4th Edition by Dimmock N J, Primrose S. B.. Blackwell Scientific Publications. Oxford.
3. Virology by Conrat H.F., Kimball P.C. and Levy J.A.Prentice Hall, Englewood Cliff, New Jersey.
4. Text Book on Principles of Bacteriology, Virology and Immunology Topley and Wilsons.
5. Molecular Biology, Pathogenesis and Control by S.J. Flint and others. ASM Press, Washington, D.C.
6. Applied Virology. 1984. Edited by EdonardKurstak. Academic Press Inc.
7. Introduction to Modern Virology by Dimmock.

M.SC. MICROBIOLOGY I SEMESTER
CORE COURSE
MB-C103 BACTERIOLOGY
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

Course Objectives: The course objectives are to provide knowledge on: landmark discoveries and contribution of several Microbiologists in the field of Microbiology, different domains classification, familiarity with the bacterial taxonomy and their conventional and molecular characterization using modern methods, knowledge of their cultivation and growth requirement, life cycles of important groups of bacteria.

Course Level Learning Outcomes: Upon successful completion of the course, students will have the knowledge and skills to:

CO1: Explain the key concepts in Microbiology and Bacteriology. Students will get the basics and understand the importance of Microbiology. Students will be acquainted with the concept of bacterial taxonomy. They will understand how Microbiology developed and what is the scope of the various branches of the subject.

CO2 Students will be able to define and state the principles of various techniques used in microbiology. The course will enable them to understand staining techniques, CFU count and characterization of microbes etc. The students will know various culture media and their applications and also understand various physical and chemical means of sterilization

CO3: Students will be able to describe morphological & physiological characters, genetic interrelationship, taxonomic sub-division of bacteria having importance in human health and economy

CO4: At the end of the course, Bacteriology will provide the better understanding of Morphological & physiological characters, taxonomic sub-division & their importance of Pathogenic Bacteria

	PO1	PO 2	PO 3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	1	-	-	3	-	-	-	1	1	2	1	1	1	-	2
CO2	1	-	-	1	1	-	-	-	1	-	-	1	-	3	-	1
CO3	1	-	-	1	1	-	-	-	1	-	-	1	-	3	-	1
CO4	1	-	-	1	1	-	-	-	1	-	-	1	-	3	-	1

M.SC. MICROBIOLOGY I SEMESTER
CORE COURSE
MB-C103 BACTERIOLOGY
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

TOPIC	TEACHING HOURS
UNIT –I History, scope and development of bacteriology, Sterilization, isolation, enrichment, pure culture and staining techniques, systematic study of bacteria; morphological, physiological, biochemical and serological studies, genetic characterization. Habitat, structure, reproduction & classification of bacteria.	**15**
UNIT- II 1. The photosynthetic bacteria; cyanobacteria, green bacteria, halobacteria and their economic importance 2. Methanogenic bacteria and their significance **3.** Chemoautotrophs and Methylotrophs: Nitrifying bacteria, sulphur oxidizers, iron bacteria and their economic importance.	**15**
UNIT- III 1. Enterobacteriaceae and related organisms, their morphological & physiological characters, genetic interrelationship, taxonomic sub-division & their importance in human health. **2.** Myxobacteria, cytophage group, filamentous & gliding chemoheterotrophs& filamentous sulphur oxidizing bacteria.	**15**
UNIT IV **Morphological & physiological characters, taxonomic sub-division & their importance of Pathogenic Bacteria**- Staphylococcus, Sterptococcus, Pnumococcus, Corynebacterium, Bacillus, Clostridium, Non-sporing anaerobes; organisms belonging to Enterobacteriaceae, Vibrios, NonfermentingBrucella, Mycobacteria, Spirochates, Actinomycetes, Rickettsiae, Chlamydie.	**15**

Suggested Books:

1. General Microbiology: R Y Stanier, Adelberg E A and J L Ingraham, Mac Millan Press Inc
2. Introduction to microbiology: Ingraham J L and Ingraham C A Thomson Brooks/ Cole
3. Principles of microbiology R M Atlas Wm C brown Publishers
4. Brock's biology of Microorganisms Madigan M T and Martinko J M Pearson Education Inc
5. Microbiology: An introduction: Tortora G J, Funke B R and Case C L Pearson Education Inc

M.SC MICROBIOLOGY I SEMESTER
CORE COURSE
MB-C104 MICROBIAL BIOCHEMISTRY AND BASIC ENZYMOLOGY
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

Course Objectives: This course deals with characteristics, properties and biological significance of the biomolecules of life. In depth knowledge of the energetics and regulation of different metabolic processes in microorganisms.

Course Level Learning Outcomes: Upon successful completion of the course, the learner will be able to –

CO1: Understanding the laws of thermodynamics, concepts of entropy, enthalpy and free energy changes and their application to biological systems and various biochemical studies and reactions. Conceptual knowledge of aerobic and anaerobic respiration and various intermediary mechanisms involved, oxidative phosphorylation

CO2: Have knowledge of major biomolecules –carbohydrates, lipids, proteins, amino acids, nucleic acids, classification, structure, function of the above mentioned biomolecules

CO3: Can explain structure of biological membrane and can describe kinetics of transport across membrane and their types

CO4: Conceptual knowledge of properties, structure, functions of enzymes, enzyme kinetics and their regulation.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	1	2	2	3	1	-	2	2	2	2	3	-	2	-	2
CO2	1	-	1	1	3	-	-	1	1	1	1	3	-	-	1	1
CO3	1	-	1	1	3	-	-	1	1	1	1	3	-	-	1	1
CO4	3	2	2	2	3	-	-	2	2	2	2	3	-	1	2	2

M.SC MICROBIOLOGY I SEMESTER
CORE COURSE
MB-C104 MICROBIAL BIOCHEMISTRY AND BASIC ENZYMOLOGY
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

TOPIC	TEACHING HOURS
Unit I 1. Biomolecules – Chemical composition and bonding, three dimensional structure, configuration and confirmation. 2. Chemical reactivity – five general types of chemical transformation of : oxidation reduction reactions, nucleophilic substitution, electron transfer with in molecules producting internal rearrangement, group transfer reaction, condensation reaction 3. Water – weak interactions in aqueous system, ionization of water, weak acid and weak base, concept of pH &pKa, Buffers (bicarbonate buffering system). 4. Principles of Bioenergentics – Entropy, enthalpy and free energy. **5.** Oxidative and Photophosphorylation, ATP production	**15**
Unit II 1. Carbohydrates: Classification, Structure, chemical feature and function. 2. Lipids – Classification, Structure, chemical feature and function 3. Amino acids, peptides and proteins - Classification, Reaction & physical properties. Three dimensional structures of protein and protein folding. **4.** Nucleotides and nucleic acids	**15**
Unit III 1. Structural features of Biomembranes, 2. **Solute transport across membranes**: Introduction, Kinetics 3. Simple diffusion, facilitated transport: Symport, antiport and uniport. **4.** Avtive Transport**:** Primary and Secondary active transport: ABC transporters, Phosphotransferase system, Drug export systems.	**15**
Unit IV 1. Enzymes – Classification and factors affecting enzyme activity 2. Allosteric Enzymes and their regulation 3. Enzyme kinetics – Equilibrium and steady state theory (MichalisMenten equation) and determination of kinetic parameters. **4.** Enzyme inhibition – reversible and irreversible inhibition, competitive, non-competitive and un-competitive inhibition	**15**

Suggested Books:

1. Biochemistry, Voet Donald and Voet J.G ., John Wiley and sons INC
2. Biochemistry, Zubay .G. - Wm.C.brown Publishers
3. The Physiology and Biochemistry of prokaryotes White .D. -Oxford Univ.press
4. Principles of Biochemistry, LehningerA.L.Cox and Nelson , CBS Publishers and Distribution Pvt.Ltd
5. Biochemistry, Stryer .L., W.H.Freeman and Co
6. Principle and Techniques –Practical Biochemistry Wilson. K. and Walker.J. -Cambridge University press
7. Biochemistry, Murray, Harpers McGraw Hill
8. Biochemistry, Satyanarayana and Chakrapani, Books and Allied Publishers
9. Fundamentals of Biochemistry, VoetDonald,J.W.Voet and Ch.W.Pratt, Jhon Willey & Sons Inc.
10. Enzyme Kinetics by Paul Engel. John Wiley and Sons. Inc., New York.

M.SC MICROBIOLOGY I SEMESTER
CORE COURSE
MB-105 PRACTICAL
(TOTAL CREDIT -04, END SEMESTER MARKS -100)

Course Learning Outcomes:

Following successful completion of the course, the student will:

CO1. To impart practical skills on sterilization and pure culture techniques

CO2. Understand the working and understand how to operate major microbiology lab instruments

CO3. To understand the methods of identification, cultivation and preservation of various Microorganisms

CO4. To develop practical knowledge on biochemical characterization of microbes

CO5. To develop anaerobic cultivation methods and isolation of bacteria

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO1	2	3	-	1	1	1	1	-	2	1	1	1	-	2	1	1
CO2	-	3	-	-	1	1	1	-	-	-	-	-	-	1	2	1
CO3	-	3	-	-	1	1	1	-	-	-	-	-	-	1	2	1
CO4	1	3	-	1	1	1	1	1	1	1	1	1	-	2	2	1

M.SC MICROBIOLOGY I SEMESTER
CORE COURSE
MB-105 PRACTICAL
(TOTAL CREDIT -04, END SEMESTER MARKS -100)

Experiment No. 1
Laboratory basic rules and regulations in the microbiology lab and the procedure of cleaning and preparation of materials for lab experiment

Experiment No. 2
Enumeration (counting) of bacteria by plate count or serial dilution -agar plate technique

Experiment No. 3
To Determine the counting of the bacterial population by the use of a spectrophotometer

Experiment No. 4
To perform the principle and methods of different staining techniques in Bacteria (Simple staining, Negative staining, Gram's staining, Acid fast staining

Experiment No. 5
To perform the Lactophenol cotton blue mounting of fungi

Experiment No. 6
To study the control of Microorganisms by physical agents: Moist Heat

Experiment No. 7
To study the control of Microorganisms by physical agents: Dry Heat

Experiment No. 8
To study the types of Physical methods: Ultraviolet radiation

Experiment No. 9
Evaluation of antiseptics by filter paper disc methods

Experiment No. 10
Preparation of basic liquid media (broth) for the routine cultivation of bacteria

Experiment No. 11
Preparation of basic solid media, agar slants and agar deep tubes for the routine cultivation of microorganisms

Experiment No. 12
To isolate the fungi from soil their identification on the basis of cultural, morphological and biochemical characteristics.

M.SC MICROBIOLOGY II SEMESTER
CORE COURSE
MB-C201MOLECULAR BIOLOGY
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

Course Objective: The objective of the course is to understand the principles and techniques of molecular biology. The students will learn the concept of gene, modulation of gene its regulation, modes of transmission including advanced knowledge in a specialized field of molecular biology

Course Level Learning Outcomes: Upon successful completion of the course, the learner will be able to –

CO1: Advanced understanding of fundamental concepts of molecular biology and genetics. Improved understanding of molecular basis of genome organization and function. Develop deep understanding of mechanism of DNA replication.

CO2: Understand mechanism of transcription in prokaryotes and eukaryotes. Enhance fine molecular understanding of operon gene regulation ion in prokaryotes. Develop understanding of the molecular basis of gene silencing and RNA processing.

CO3: Knowledge of mechanism of translation and Co- & post- translation modification in prokaryotic and eukaryotic system. To get an insight in to the wide range of mechanisms required for gene regulation in different organisms.

CO4: Ability to understand the protein localization in various organelles and learn the molecular mechanism of antisense and ribozyme technology.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	-	2	3	3	-	-	1	3	2	2	3	-	3	2	2
CO2	3	-	2	2	3	-	-	1	2	3	2	3	-	3	2	3
CO3	3	-	2	2	3	-	-	1	2	3	2	3	-	3	2	3
CO4	3	3	2	3	3	1	-	2	2	3	3	3	3	2	2	3

M.SC MICROBIOLOGY II SEMESTER
CORE COURSE
MB-C201MOLECULAR BIOLOGY
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

TOPIC	TEACHING HOURS
Unit I 1. Introduction of molecular biology and genetics. 2. Genome organization – genome, c-value, c-value paradox, genome complexity, 3. DNA Replication Prokaryotic and eukaryotic DNA replication, mechanism of DNA replication, enzymes and accessory proteins involved in DNA replication.	**15**
Unit II 1. Transcription Prokaryotic transcription and eukaryotic transcription, RNA polymerase, General and specific transcription factors, regulatory element and mechanisms of transcription regulation. 2. Transcriptional and post transcriptional gene silencing. 3. Modification of RNA 5'-cap formation, transcription termination, 3' end processing and polyadenylation, splicing, Editing, Nuclear export of mRNA, mRNA stability.	**15**
Unit III 1. Translation Prokaryotic and eukaryotic translation, the translation machinery, mechanisms of initiation, elongation and termination, regulation of translation. **2.** Co- and Post- translational modifications of proteins.	**15**
Unit IV 1. Protein localization and transport Synthesis of secretary and membrane, import into nucleus. Mitochondria E. R., Golgi complex, chloroplast, and peroxisomes, Receptor mediated endocytosis. 2. Antisense and ribozyme technology Molecular mechanism of antisense molecules, inhibition of splicing, polyadenylation and translation. Disruption of RNA structureand capping biochemistry of ribozyme; hammerhead, hairpin and other ribozymes, strategies for designing ribozyme, application of antisense and ribozyme technologies.	**15**

Suggested Books:

1. Lodish et al., Molecular cell Biology, 4th Edition, W.H. Freeman & Company, 2000.
2. Smith & Wood, Cell Biology, 2nd Edition, Chapman & Hall, London, 1996.
3. Watson et al., Molecular Biology of the gene, 5th Edition, Pearson Prentice Hall. USA, 2003.
4. B. M. Turner, Chromatin & Gene regulation, 1st Edition, Wiley-Blackwell, 2002.
5. Benjamin Lewin, Gene X, Edition, Jones and Barlett Publishers, 2007.
6. J.D. Watson, N.H. Hopkins, J.W Roberts, J. A. Seitz & A.M. Weiner; Molecular Biology of the Gene, 6th Edition, Benjamin Cummings Publishing Company Inc, 2007.
7. Alberts et al; Molecular Biology of the Cell, 4th edition, Garland, 2002.
8. Recombinant DNA technology by Watson et. al., (Scientific American Books).
9. Principles of Gene Manipulation by Old and Primrose.(Blackwell).
10. Molecular Biotechnology by Glick.

M.SC MICROBIOLOGY II SEMESTER
CORE COURSE
MB -C202MICROBIAL GENETICS
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

Course Objectives: The objective of this course is to provide a detailed overview of DNA Damage and DNA repair. The learner will also the gene mapping of E.coli, Molecular markers for genome analysis. as well as new generation recombinant DNA vaccines

Course Level Learning Outcomes: Upon successful completion of the course, the learner will be able to –

CO1: The students will remember about basic concept of mutation and recombination, types of DNA damage and repair systems

CO2: The students will understand the methods of genetic analysis types of Recombination, QTL mapping and molecular markers in genome analysis

CO3: Students can apply the Principle of mapping genes and can identify group of genes for a phenotype

CO4: Student apply molecular tools for production of recombinant proteins

	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	2	2	-	2	-	-	2	1	3	2	3	-	2	2	2
CO2	3	2	2	-	2	2	-	2	1	3	2	3	-	2	3	3
CO3	3	2	2	-	2	-	-	2	1	3	2	3	-	2	1	1
CO4	3	2	2	-	2	-	-	2	3	3	2	3	-	2	2	2

M.SC MICROBIOLOGY II SEMESTER
CORE COURSE
MB -C202MICROBIAL GENETICS
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

TOPIC	TEACHING HOURS
UNIT –I 1. Gene as unit of mutation and recombination. 2. Molecular nature of mutations; mutagens. 3. Type of DNA damage (deamination, oxidative damage, alkylation, pyridine dimmers). 4. Ame's test for mutagenesis **5.** DNA repair- photorepair, excision or dark repair, recombinational repair, SOS repair.	**15**
UNIT-II 1. Methods of genetic analysis and genetic mapping, Pedigree analysis, lod score for linkage testing. 2. Recombination - Homologus recombination - Holiday junction, site specific recombination - FLP/FRT and Cre lox recombination, Rec A and other recombinases 3. Quantitative genetics: Polygenic inheritance, heritability and its measurements, QTL mapping. **4.** Molecular markers in genome analysis, RFLP, RAPD, AFLP, STS, SCAR (Sequence characterized amplified regions), microsatellite, SSCP, QTL.	**15**
UNIT- III 1. Bacterial genetic system: transformation, conjugation and transduction. Bacterial genetics map with reference to *E.coli*. **2.** Complementation analysis, cir-trans test, deletion mapping, Benzer's concept of cistron, concept of overlapping genes.	**15**
UNIT- IV 1. Southern, Northern and florescence in situ hybridization for genome analysis 2. Chromosome micro-dissection and micro-cloning. **3.** Important application of advances in microbial genetics. Production of proteins. **4.** Conventional as well as new generation recombinant DNA vaccines, design and advantages	**15**

Suggested Books:

1. Molecular Genetics of Bacteria by J. W. Dale. John Wiley and Sons.
2. Modern Microbial Genetics. Streips and Yasbin. Niley Ltd.
3. Moleculat Biology of the Gene , J.D. Watson, N.H. Hoppkins, J.W. Roberts, J.A. Steitz and A.M. Weiner. The Benjamin / Cummings Publications Co. Inc. California.
4. Gene XI by Lewin Oxford University Press..
5. Microbial Genetics by Frefielder. 4th Edition.
6. Molecular Genetics of Bacteria, Larry, Snyder and Wendy, Champness, ASM Publications.
7. Methods of General and Molecular Bacteriology, 1993. Edited by Philip. Gerhardt, ASMPublications.

M.SC MICROBIOLOGY II SEMESTER
CORE COURSE
MB -C203 BIOINSTRUMENTATION
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

Course Objectives: To introduce the learner to the basic concept of qualitative and quantitative analysis of various biological samples. Students would be taught about the biophysical and biochemical techniques currently available to investigate the structure and function of the biological macromolecules. Learner would be made aware about the various separation techniques and its instrumentation, principles behind each technique, make them familiar with various methods of analysing the output data and to build a strong foundation in the area of microbiology.

Course Learning Outcomes: Upon successful completion of the course, the student will able to:

CO1: To understand and interpret the basic principles, Instrumentation and applications of UV-Visible spectrophotometry, Infrared (IR) spectroscopy, Fluorescence spectroscopy, Mass spectroscopy.

CO2: The students will gain knowledge oF principle, instrumentation and applications Raman spectroscopy, Electron spin resonance (ESR) spectroscopy, Nuclear magnetic resonance (NMR) Spectroscopy, Circular- Dichroism (CD) spectroscopy, X-ray Crystallography.

CO3: Understand and Interpret Basic Principle, Types and Applications of Centrifugation, Chromatography, Electrophoresis, Autoradiography

CO4: Can explain basic principle and components of Microscopy, the process sequencing techniques for proteins and nucleic acids , correctly interpret the Detection of molecules using flow cytometry and *in-situ* localization by hybridization techniques such as FISH & GISH

	PO 1	PO 2	PO 3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	3	2	2	3	1	-	3	2	3	2	3	3	-	1	2
CO2	3	3	2	2	3	1	-	3	2	3	2	3	3	-	1	2
CO3	3	2	2	1	2	1	-	2	1	2	1	3	3	-	1	2
CO4	3	3	2	1	3	1	-	3	1	3	1	3	3	-	2	2

M.SC MICROBIOLOGY II SEMESTER
CORE COURSE
MB -C203 BIOINSTRUMENTATION
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

TOPIC	TEACHING HOURS
Unit I – 1. Photometry – Basic principles, Instrumentation and applications of UV-Visible spectrophotometry 2. Infrared (IR) spectroscopy and its applications 3. Fluorescence spectroscopy – principle, instrumentation and applications. **4.** Mass spectroscopy – Mass analyzers, principle, instrumentation and applications.	**15**
Unit II - 1. Raman spectroscopy and its applications 2. Electron spin resonance (ESR) spectroscopy and applications 3. Nuclear magnetic resonance (NMR) Spectroscopy – principle, instrumentation and applications 4. Circular Dichroism (CD) spectroscopy – principle, instrumentation and applications 5. X-ray Crystallography – principle, instrumentation and applications	**15**
UNIT III – 1. Centrifugation – basic principle, types and applications 2. Chromatography: Principle, types and applications of Paper, Thin layer, High performance liquid chromatography; Column Chromatography – Gel filtration, Ion exchange chromatography, affinity chromatography, adsorption chromatography. 3. Electrophoresis: Principle, types and applications; Agarose gel, PAGE, SDS-PAGE, Iso-electric focusing, Two Dimensional gel electrophoresis, Immuno-electrophoresis, Capillary electrophoresis, Pulse Field gel electrophoresis. **4.** Autoradiography – Principle and applications, radioisotopes used in biology and their application.	**15**
Unit IV – 1. Microscopy – Basic principle and components of microscope, phase contrast and fluorescent and Confocal microscopes 2. Electron microscopy – principle and applications 3. Sequencing techniques for proteins and nucleic acids **4.** Detection of molecules using flow cytometry and *in-situ* localization by hybridization techniques such as FISH and GISH	**15**

Suggested Books:

1. Instrumental Methods of Analysis. H.H. Willard, L.L. Merritt Jr. and others. CBS Publishers and Distributors.
2. Instrumental Methods of Chemical Analysis. Chatwal G and Anand, S. Himalaya Publishing House, Mumbai.
3. A Biologists Guide to Principles and Techniques of Practical Biochemistry. Williams, B.L. and Wilson, K.
4. Spectroscopy. Volume 1. Edited by B.B. Straughan and S. Walker. Chapman and Hall
5. Ltd.
6. Chromatography: Concepts and Contrasts- 1988 by James Miller. John Wiley and Sons.
7. Inc., New York.
8. Analytical Biochemistry by Holme.
9. Introduction to High Performance Liquid Chromatography by R. J. Hamilton and P. A.

M.SC MICROBIOLOGY II SEMESTER
CORE COURSE
MB -C204 IMMUNOLOGY
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

Course Objectives: The objective of this course is to provide a detailed overview of immune system to the learners. The learner will understand structure, organization and functions of various components of the immune system like antigen, antibody, organs, MHC, cytokines and others in the defence system of the body. It would also make them understand the concepts of innate and adaptive immunity, immune diversity and specificity, autoimmunity, hypersensitivity, transplantation and others.

Course Level Learning Outcomes: Upon successful completion of the course, the learner will be able to-

CO1: Describe the fundamental bases of immune system and immune response, Explain about the importance of innate immunity and acquired immunity, Describe the structure and organization of various components of the immune system

CO2: Analyse the genetic basis for the expression of immune cell receptors and generation of immunological diversity, Antigens antibody interactions, Major histocompatibility complex and Regulation of immune response

CO3: Understand the operation and the mechanisms of Complement system, Cell mediated cytotoxicity, Hypersensitivity, Catalytic antibodies and comprehend the techniques and the underlying principles used in Hybridoma Technology and monoclonal antibodies

CO4: The students will gain knowledge about Host parasite interaction, general principles of cell communication, cell adhesion and different roles in causing oncogenesis

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	-	1	2	3	-	-	1	1	2	1	3	-	-	-	1
CO2	3	1	1	2	3	-	-	1	1	2	1	3	-	-	-	1
CO3	3	-	1	1	3	-	-	1	1	3	1	3	-	1	-	2
CO4	3	-	1	1	3	-	-	1	1	3	1	3	-	1	-	2

M.SC MICROBIOLOGY II SEMESTER
CORE COURSE
MB -C204 IMMUNOLOGY
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

TOPIC	TEACHING HOURS
Unit I 1. Immune response: innate and adaptive immune system, cells and molecules of immune system, Cells of the Immune system : Hematopoiesis and differentiation , Lymphocyte trafficking , B-lymphocyte , Macrophage Dendritic cells , Natural killer and Lymphokine activated killer cells, Eosinophils , Neutrophils and Mast cells . 2. Clonal selection theory. 3. Organization and structure of lymphoid organ. 4. Nature and biology of antigens and super antigens. **5.** Antibodies structure and function.	**15**
Unit II- 1. Antigens antibody interactions. 2. Major histocompatibility complex. 3. BCR & TCR, generation of diversity. 4. Regulation of immune response: - antigen processing and presentation , generation of humoral and cell mediated immune response . - Activation of B & T –lymphocytes. - Cytokines and their role in immune regulation. - T-cell regulation, MHC restriction. - Immunological tolerance.	**15**
Unit III – 1. Complement system. 2. Cell mediated cytotoxicity: Mechanism of T cell and NK cell mediated lysis, Antibody dependent cell mediated cytotoxicity, macrophage mediated cytotoxicity. 3. Hypersensitivity. **4.** Catalytic antibodies **5.** Hybridoma Technology and monoclonal antibodies.	**15**
Unit IV – 1. Host parasite interaction 2. Cell signaling Hormones and their receptors, cell surface receptor, signaling through G-protein coupled receptors, signal transduction pathways, second messengers, regulation of signaling pathways, 3. Cellular communication Regulation of hematopoiesis, general principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins, neurotransmission and its regulation. **4.** Cancer immunology	**15**

Suggested Readings:

1. Kuby Immunology, Thomas J. Kindt, Richard A. Goldsby, Barbara A. Osborne , Janis Kuby,
2. Immunology and Immunopathology by Stewart.
3. Cellular and Molecular Immunology by Abul K. Abbas et al.
4. Textbook of Immunology by Barret.
5. Essential Immunology by Roitt, Brostoff, Male, Harcourt Brace & Company (5th Edition), Mosby (6th Edition)
6. Immunology by J.Kuby, Richard A. Goldsby, Thomas J. Kindt, Barbara A. Osborne, Freeman & Company Mosby publishers.

M.SC MICROBIOLOGY I SEMESTER
CORE COURSE
MB-205 PRACTICAL
(TOTAL CREDIT -04, END SEMESTER MARKS -100)

CO1. To develop practical knowledge on the estimation of macromolecules

CO2. To demonstrate the estimation of biomolecules quantitatively

CO3. To impart practical knowledge on the production, separation and partial purification of enzymes

CO4. Understand the procedure of separating compounds by using chromatography

CO5. To impart hands-on training in DNA and RNA isolation methods.

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO1	2	-	-	1	1	-	1	-	2	1	1	1	-	2	1	1
CO2	-	-	-	-	1	-	1	-	-	-	-	-	-	1	2	1
CO3	-	-	-	-	1	-	1	-	-	-	-	-	-	1	2	1
CO4	1	-	-	1	1	-	1	1	1	1	1	1	-	2	2	1

M.SC MICROBIOLOGY I SEMESTER
CORE COURSE
MB-205 PRACTICAL
(TOTAL CREDIT -04, END SEMESTER MARKS -100)

Experiment No. 1
Isolation of DNA from plant materials
Experiment No. 2
To perform electrophoresis of a DNA sample
Experiment No. 3
Determination of Purity of Nucleic Acid (DNA) By UV Absorption Method
Experiment No. 4
To study the concept of Southern Blotting: Principle, Procedure, and Applications
Experiment No. 5
To study autosomal/sex-linked disorder by pedigree analysis in humans
Experiment No. 6
Restriction Enzymes in Genome Mapping and Analysis
Experiment No. 7
To study the separation, purification, identification and application of compounds by Chromatography
Experiment No. 8
To Detect the Ag-Abs interaction by double immune diffusion method
Experiment No. 9
To study the Serological diagnosis by Tube agglutination test (Widal test)
Experiment No. 10
Determination of Blood group by Slide agglutination test

M.SC MICROBIOLOGY III SEMESTER
CORE COURSE
MB-C301 MICROBIAL METABOLISM
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

Course Objectives: The objective of this course is to provide a detailed overview of growth kinetics of microorganism to the learners. The learner will understand metabolic diversity among Microorganisms. It would also make them understand the concepts of catabolism and anabolism

Course Level Learning Outcomes: Upon successful completion of the course, the learner will be able to-

CO1: Explain the mathematical expression of growth, can measure growth yields, generation time. Students can also describe the effect of nutrient concentration and environmental factors on growth rate.

CO2: The students will gain knowledge about Microbial nutrition, metabolic diversity among Microorganisms.

CO3: Students will be able to describe catabolism of Carbohydrates, Lipid, and Amino acid.

CO4: Describe Anabolism of Carbohydrates, Lipids, Amino Acids, Nucleic Acids, Polyamines

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	1	1	2	3	-	-	1	1	2	1	2	-	-	-	1
CO2	2	1	1	2	3	-	-	1	1	2	1	3	-	-	-	1
CO3	3	-	1	1	3	-	-	1	1	3	1	2	-	1	-	2
CO4	2	-	1	1	3	-	-	1	1	3	1	3	-	1	-	1

M.SC MICROBIOLOGY III SEMESTER
CORE COURSE
MB-C301 MICROBIAL METABOLISM
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

TOPIC	TEACHING HOURS
Unit I 1. Growth and cell division: mathematical nature and expression of growth. 2. Measurement of growth, growth yields, steady state growth and continuous growth. 3. Effect of nutrient concentration in growth rate. **4.** Effect of environment on microbial growth	**15**
Unit II **1.** Overview of Microbial nutrition. **2.** Metabolic diversity among Microorganisms • Photosynthesis in microorganisms; Role of chlorophylls, Carotenoids and phycobilins. • Chemolithotrophy: Hydrogen-ion-nitrate-oxidizing bacteria; nitrate and sulfate reduction. • Methanogenesis and acetogenesis:fermentation's-diversity. • role of anoxic decompositions: nitrogen metabolism, nitrogen fixation; hydrocarbon transformation.	**15**
Unit III 1. Carbohydrate Catabolism: Glycolysis, Citiric acid cycle, Pentose phosphate pathway, EmbedenMayerhoff pathway. 2. Lipid Catabolism –Oxidation of fatty acids. **3.** Amino acid oxidation and production of Urea.	**15**
Unit IV 1. Carbohydrate Anabolism – Gluconeogensis, glyoxalate pathway and regulation. 2. Lipid Biosynthesis 3. Biosynthesis of Amino acids – tryptophan, alanine, cysteine, histidine, glutamate **4.** Biosynthesis of nucleotides and poly amines	**15**

Suggested Books:

1. Microbial Physiology and Metabolism, Caldwell D.R., Brown Publishers.
2. Microbial Physiology, Moat A.G. and Foster J. W. 1999.. Wiley.
3. Advances in Microbial Physiology. A.H. Rose. Academic Press, New York
4. Biochemistry by Geoffrey L. Zubay. 4th Edition. Brown Co, USA. 1999.
5. Microbial Physiology by A.G. Moat, J. W. Foster, M. P. Spector. 3rd Edition. John Wiley & Sons. 2002
6. Lehninger Principles of Biochemistry by D. L. Nelson, M. M. Cox. 6th Edition. W. H. Freeman. 2012
7. The Physiology and Biochemistry of Prokaryotes by D. White, J. Drummond, C. Fuqua. 4 th Edition. Oxford University Press. 2011.
8. Microbial Biochemistry by G. N. Cohen. 2nd Edition. Springer. 2014.
9. Lippincott's Illustrated Reviews: Biochemistry edited by D. R. Ferrier. 6th Edition. Lippincott Williams & Wilkins. 2013
10. Biochemical Calculations: by Irwin H. Segel. 2nd Edition. Wiley. 2004. 8. Understanding Enzymes by T. Palmer, E.Horwood. 3rd Edition. Wiley. 1991.

M.SC MICROBIOLOGY III SEMESTER
CORE COURSE
MB -C302BIOSTATISTICS, COMPUTER APPLICATION AND BIOINFORMATICS
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

Course Objectives: The objective of this course is to provide a detailed knowledge of description, classification, tabulation of data, its graphical representation and can do the statistical analysis. Have basic knowledge computers and bioinformatics

Course Level Learning Outcomes: Upon successful completion of the course, the learner will be able to-

CO1: To understand various statistical terminologies and their description, classification, tabulation of data, graphical representation and Measures of central tendency and dispersion.

CO2: Student can comparatively analyse experimental data by utilizing different statistical modules

CO3: Student can explain the basic working of a computer in the modern era and learnt the use of different software, internet and its application

CO4: The students will gain knowledge of scope of bioinformatics, to learn various computational techniques and online tools of bioinformatics

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	1	1	2	3	-	2	1	1	2	1	2	-	-	-	1
CO2	2	1	1	2	3	-	2	1	1	2	1	3	-	-	-	1
CO3	3	-	1	1	3	-	1	1	1	3	1	2	-	1	-	2
CO4	2	-	1	1	3	-	2	1	1	3	1	3	-	1	-	1

M.SC MICROBIOLOGY III SEMESTER
CORE COURSE
MB -C302BIOSTATISTICS, COMPUTER APPLICATION AND BIOINFORMATICS
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

TOPIC	TEACHING HOURS
Unit I 1. Brief description, classification, tabulation of data and its graphical representation 2. Measures of central tendency and dispersion mean; median; mode range. Standard division, variance. 3. Simple linear regression and correlation. **4.** Probability and Probability distribution.	**15**
Unit II 1. Test of significance; null hypothesis, alternative hypothesis, two types of errors, Level of significance, T test. 2. Analysis of variance in one way classification (one factor analysis). 3. Analysis of variance in two way classification (two factor analysis). **4.** Chi Square test	**15**
Unit III 1. Introduction of digital computers organization low level and high level language binary number system. 2. Flow chart and programing techniques. 3. Introduction to data structure and data base concepts, 4. Introduction to MS-office software, covering Word processing. spreadsheets and presentation 5. Introduction to internet and its application.	**15**
Unit IV 1. Bioinformatics – an overview, introduction and scope of bioinformatics. 2. Biological database – Primary sequence database (Protein and DNA), Secondary database, composite database 3. Searching pairwise database BLAST, FASTA, Multiple sequence alignment (ClustalW, Psi BLAST). **4.** Computer aided drug designing.	**15**

Suggested Books:

1. Statistics in biology, Bliss, C.I.K. McGraw Hill, NewYork.
2. Practical Statistics for experimental biologist Wardlaw, A.C.
3. How Computers work, Ron White. Tech. Media
5. How the Internet Work, Preston Gralla Tech. Media.
6. Statistical Methods in Biology, Bailey, N.T. J. English Univ. Press.
7. Biostatistics - 7th Edition by Daniel
8. Statistics for Biologist, Campbell R.C., Cambridge University Press, UK.
9. INTERNET – CDC publication, India.
10. Bioinformatics. 1998 by Baxevanis

M.SC MICROBIOLOGY III SEMESTER
CORE COURSE
MB-C303 GENETIC ENGINEERING
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

Course Objectives: The course objectives are to provide knowledge on fundamental and applied aspects of genetic and molecular biology. The content include Genetic Engineering, patenting, Gene cloning, Site directed Mutagenesis, Gene Therapy and to understand the tools and techniques used in DNA technology

Course Level Learning Outcomes: Upon successful completion of the course, the learner will be able to-

CO1: Student can relate the Scope of Genetic Engineering, patenting and modification of enzymes

CO2: Student can understand the basic steps of gene cloning and the role of enzymes and vectors responsible for gene manipulation and transformation.

CO3: Student of this course have knowledge on Mutagenesis and Protein Engineering, gene regulation and Processing of Recombinant proteins

CO4: The students will gain knowledge about Transgenic and gene Knock out Technologies, chromosome engineering, Gene Therapy, gene editing, regulation and silencing.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	-	1	2	3	-	2	1	1	2	1	3	-	-	2	1
CO2	3	1	1	2	3	-	-	1	1	2	1	3	-	-	2	1
CO3	3	-	1	1	3	-	2	1	1	3	1	3	-	1	2	2
CO4	3	-	1	1	3	-	2	1	1	3	1	3	-	1	2	2

M.SC MICROBIOLOGY III SEMESTER
CORE COURSE
MB-C303GENETIC ENGINEERING
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

TOPIC	TEACHING HOURS
Unit I 1. Scope of Genetic Engineering. 2. Isolation of enzymes, in-vitro synthesis of DNA and patenting of life forms. 3. Restriction enzymes and modification enzymes. 4. Nucleic acid Purification and Yield Analysis. **5.** Nucleic Acid Amplification, PCR and Its application	**15**
Unit II 1. Gene cloning Vectors Plasmids, bacteriophage, phagemides, cosmids, Artificial Chromosomes. 2. Restriction mapping of DNA fragments and Map construction. 3. cDNA Synthesis - mRNA enrichment, reverse transcription, DNA primers, linkers, Adapters and their chemical synthesis, Library construction and screening. 4. Alternative strategies of Gene Cloning. Cloning interacting genes- Two and three hybrid systems. **5.** Nucleic acid microarrays.	**15**
Unit III 1. Site directed Mutagenesis and Protein Engineering. 2. How to study the Gene Regulation? DNA transfection, Northern blot, Primer extension, SI mapping, Rnase protection assay. 3. Expression Strategies for heterologous genes Expression in bacteria, expression in Yeast, expression in insects and insect cells, expression in mammalian cells. 4. Processing of Recombinant proteins. Purification and stabilization of proteins.	**15**
Unit IV 1. Phase Display. 2. T-DNA and Transposon Tagging 3. Transgenic and gene Knock out Technologies Targeted gene replacement, chromosome engineering. 4. Gene Therapy. Vector engineering, Strategies of delivery, gene replacement/ augmentation, gene correction, gene editing, regulation and silencing.	**15**

Suggested Books:

1. S.B. Primrose, R.M. Twyman and R.W.Old; Principles of Gene Manipulation. 6th Edition, S.B.University Press, 2001.
2. J. Sambrook and D.W. Russel; Molecular Cloning: A Laboratory Manual, Vols 1-3, CSHL, 2001.
3. Brown TA, Genomes, 3rd ed. Garland Science 2006
4. Selected papers from scientific journals.
5. Technical Literature from Stratagene, Promega, Novagen, New England Biolab etc.
6. Genetic Engineering by SandhyaMitra
7. Gene Technology by SN Jogdand.

M.SC MICROBIOLOGY III SEMESTER
ELECTIVE COURSE
MB-E304COMPUTATIONAL BIOLOGY
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

Course Objectives: The course objectives are to provide knowledge on biological databases, methods and algorithms, molecular phylogenetics, genomics and gene annotation

Course Level Learning Outcomes: Upon successful completion of the course, the learner will be able to-

CO1: Student will able to remember different types of databases in terms of biological information and different formats of molecular biological data

CO2: Student will be able to understand methods and algorithms of pairwise and multiple sequence alignments, different approaches of motif detections, concept of orthology, paralogy and homology

CO3: Student will be able to apply laws of molecular phylogenetics for evaluating and interpretation of evolutionary trees.

CO4: Student will be able to analyse Organization and structure of prokaryotic and eukaryotic genomes. Genome annotation and databases

	PO1	PO 2	PO 3	PO4	PO5	PO6	PO7	PO8	PO9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO1	3	-	1	2	3	-	-	1	1	2	1	3	-	-	2	1
CO2	3	1	1	2	3	-	-	1	1	2	1	3	-	-	2	1
CO3	3	-	1	1	3	-	-	1	1	3	1	3	-	1	2	2
CO4	3	-	1	1	3	-	-	1	1	3	1	3	-	1	2	2

M.SC MICROBIOLOGY III SEMESTER
ELECTIVE COURSE
MB-E304COMPUTATIONAL BIOLOGY
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

TOPIC	TEACHING HOURS
Unit I: Biological Databases: Introduction. Types of databases in terms of biological information content. Protein and gene information resources. Different formats of molecular biology data. Specialized resources for genomics, proteomics and metabolomics.	**15**
Unit II: Sequence Alignment: Methods and algorithms of pairwise and multiple sequence alignment. Global and local alignment. Alignment scoring matrices. Database similarity searching. Different approaches of motif detection. Concept and use of protein families. Concept of orthology, paralogy and homology in gene and protein sequences	**15**
Unit III: Molecular Phylogenetics: Methods and tools for phylogenetic analysis. Creation evaluation and interpretation of evolutionary trees. Advantages and disadvantages of phenetic and cladistic approaches.	**15**
Unit IV: Genomics and Gene Annotation: Organization and structure of prokaryotic and eukaryotic genomes. Genome annotation and databases. Automated in-silico methods of finding gene and relevant features. Genome Sequencing using first and seconding generation sequencing methods. Advantages of genome sequencing projects in modern biological research.	**15**

Suggested Books:

1. Introduction to Computational Biology: An Evolutionary Approach by Haubold, Wiele. 1st edition. Springer International. 2006.
2. Introduction to Bioinformatics by A. Lesk. 3rd edition. OUP India. 2009.
3. Statistical methods in Bioinformatics: An introduction by W. Ewens, G.R. Grant. 2nd Edition. Springer-Verlag. 2006.
4. Bioinformatics: Sequence and genome analysis by D. Mount. 2nd edition. Cold Spring Harbor Lab Press. 2004.
5. Bioinformatics: A practical guide to the analysis of genes & proteins. Edited by Baxevanis, Outlette. 2nd edition. John Wiley and Sons. 2001.
6. An Introduction to Protein Informatics by K-H Zimmermann. 1st edition, Springer International. 2007.
7. Fundamental Concepts of Bioinformatics by Krane. 1st edition. Pearson Education. 2003. 8. Discovering Genomics, Proteomics and Bioinformatics by Campbell. 2nd edition. Campbell Pearson Education. 2007.
8. Structural bioinformatics: an algorithmic approach by F. J. Burkowski. 1st edition, Chapman & Hall/CRC. 2009.
9. Structural Bioinformatics edited by J. Gu, P.E. Bourne. 2nd Edition. Wiley-Blackwell. 2009.

M.SC MICROBIOLOGY III SEMESTER
ELECTIVE COURSE
MB-E305 MICROBIAL GENOMICS AND PROTEOMICS
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

Course Objectives: To introduce the learner to the basic concept of functional and structural genomics, its Impact in agriculture, environment and medicine, use of genome sequencing for creating gene libraries, analysis of DNA and protein and able to use internet and networking for filing patents and copyrights.

Course Level Learning Outcomes: Upon successful completion of the course, the learner will be able to-

CO1: Student will able to understand concept of functional and structural genomics and their use in agriculture, environment and medicine

CO2: Student can apply various cloning approaches to create gene libraries

CO3: Student will be able to evaluate the structure of proteins using tools like swissprot and can analyse DNA using tools such as microarray and creating DNA chips

CO4: Student will be able to evaluate the database such as EMBL, NCBI and learned to file patents and copyrights.

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO1	3	1	1	2	3	-	-	1	1	2	1	3	-	-	2	1
CO2	3	1	1	2	3	-	-	1	1	2	1	3	-	-	2	1
CO3	3	1	1	1	3	-	2	1	1	3	1	3	-	1	2	2
CO4	3	1	1	1	3	-	-	1	1	3	1	3	-	1	2	2

M.SC MICROBIOLOGY III SEMESTER
ELECTIVE COURSE
MB-E305MICROBIAL GENOMICS AND PROTEOMICS
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

TOPIC	TEACHING HOURS
Unit I The genomic era-functional and structural genomics, current status of microbial genomics projects. Impact in agriculture, environment and medicine.	**15**
Unit II The strategies: whole genome sequencing, shotgun and clone by clone approach. Sequencing methods, large insert cloning vector, gene libraries.	**15**
Unit III Sequence analysis, Swissprot and other protein analysis tools, BLAST and DNA analysis tools, microarray and design of chips.	**15**
Unit IV The databases like EMBL gene bank, NCBI etc., use of internet and networking, submission of data to gene banks patents and copyrights.	**15**

Suggested Books:

1. MicrobialGenomesRead, T D. Nelson, K E, FRASERraser, C M. . USA: Humana Press, Inc.,
2. Discovering Genomics, Proteomics and BioinformaticsHEYEReyer, L. Camlbell, A. USA Cold Spring Harbor Lab. Press, 2006. 352 p. ISBN 0-8053-4722-4
3. Concepts and Techniques in Genomics and Proteomics, N. Saraswathy and P. RamalingamWooodhead publishing
4. Genomics and Proteomics: Principles, Technologies, and Applications. D. Thangadurai, J. Sangeetha CRC Press

M.SC MICROBIOLOGY I SEMESTER
CORE COURSE
MB-306 PRACTICAL
(TOTAL CREDIT -04, END SEMESTER MARKS -100)

CO1. To gain an understanding of introductory and applied Bioinformatics

CO2. Determine the effect of environmental factors influencing the growth of microorganisms

CO 3: Perform basic laboratory experiments in Biochemistry, Genetics and Bioinformatics

CO4. To associate the principle and instrumentation of Laboratory Instruments and to apply bioanalytical

CO5. To impart knowledge for the use and operation of microscopes.

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO1	2	2	-	1	1	1	1	-	2	1	1	1	-	2	1	1
CO2	-	2	-	-	1	1	1	-	-	-	-	-	-	1	2	1
CO3	-	2	-	-	1	1	1	-	-	-	-	-	-	1	2	1
CO4	1	2	-	1	1	1	1	1	1	1	1	1	-	2	2	1

M.SC MICROBIOLOGY I SEMESTER
CORE COURSE
MB-306 PRACTICAL
(TOTAL CREDIT -04, END SEMESTER MARKS -100)

Experiment No. 1
Determination of bacterial growth by turbidity measurements (spectrophotometer method)
Experiment No. 2
To Study Bioinformatics with a basic local alignment search tool (BLAST) and fast alignment (FASTA)
Experiment No. 3
Identification of appropriate hypothesis testing procedure based on the type of outcome variable and number of samples by Chi-Square Test
Experiment No. 4
To familiarize with the use of a wide variety of internet applications, and biological databases by applying these methods for the research purpose
Experiment No. 5
Sequence alignment & phylogenetic analysis by using different tools
Experiment No. 6
Introduction to bioinformatics databases: NCBI, EMBL, etc.
Experiment No. 7
To understand the theoretical and practical development of useful tools for automation of complex computer jobs, and making these tools accessible on the network from a Web browser.
Experiment No. 8
Analysis of Variance one-way and two-way

M.SC MICROBIOLOGY III SEMESTER
CORE COURSE
MB-C401MEDICAL MICROBIOLOGY
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

Course Objectives: The objectives of this course are to provide basic understanding of pathogenic microorganisms, disease due immune failure, common viral infections, diagnosis of important disease/syndrome and General concepts in epidemiology and disease control-conventional and new generation vaccines

Course Level Learning Outcomes: Upon successful completion of the course, the learner will be able to-

CO1: Student will able to remember medically important microorganisms, dermatophytes dimorphic fungi, opportunistic fungal pathogen.

CO2: Student will be able to understand immunological reactions due to transplantation, intercellular, parasites helminthes & viruses and immunological malfunction

CO3: The students will gain knowledge about Common human infection of virus, protozons, Metazoans

CO4: Student will be able learn about Strategies/approaches in the diagnosis of important disease/syndrome and also learn concepts in epidemiology and disease control

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO1	3	-	1	2	3	-	-	1	1	2	1	3	-	-	-	1
CO2	3	1	1	2	3	-	-	1	1	2	1	3	-	-	-	1
CO3	3	-	1	1	3	-	-	1	1	3	1	3	-	1	-	2
CO4	3	-	1	1	3	-	-	1	1	3	1	3	-	1	-	2

M.SC MICROBIOLOGY III SEMESTER
CORE COURSE
MB-C401MEDICAL MICROBIOLOGY
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

TOPIC	TEACHING HOURS
UNIT –I Early discovery of pathogenic microorganism; development of bacteriology of scientific disciplines; Normal microbial flora of the human host; role of resident flora; Classification of medically important microorganisms, dermatophytes dimorphic fungi, opportunistic fungal pathogen.	**15**
UNIT-II 1. Transplantation immunology 2. Immunity of infectious agents (intercellular, parasites helminthes & viruses) 3. Tumor Immunology. 4. AIDS and other Immunodeficiency. **5.** Autoimmunity	**15**
UNIT-III Common viral infection of human Herpes, Arbovirus, HIV (Symptoms, transmission, control, culture and reproduction); important protozons (Malaria, Amoebiasis, Taxoplasmosis, trypanosomiases, Leshmaniasis, Anaplasmosis); Metazoans: trematodes, Nematodes (Schistomiasis, Filariasis, Hookworms, Round worms).	**15**
UNIT IV Strategies/approaches (conventional and modern) in the diagnosis of important disease/syndrome: meningitis, urinary tract infection, sexually, wound infection etc. General concepts in epidemiology and disease control-conventional and new generation vaccines	**15**

Suggested Books

1. Medical Microbiology by MIMS, Play Fair, Roitt& Mosby Publishers,
2. Medical Microbiology by Melnick.
3. Textbook of Microbiology by Ananthanarayan, C.K.J.Panikar, Oreint Longman Ltd.
4. Medical Microbiology by David Greenwood, Richard C.B.Slack, John.F.Peutherer.
5. Medical Microbiology – A Clinical perspective by J.B.Sharma, paras publishing.
6. Medical Microbiology by Patrick R.Murray, Ken.S.Rosenthal, George.S.Kobayashi, Michael A.Ptaller.
7. Pharmaceutical Microbiology edited by W.B. Hugo & A.D. Russell, 6th Edition, Black well science.
8. Microbiology in clinical practice by Shanson D.C., 2nd edition, London; Wright

M.SC MICROBIOLOGY III SEMESTER
CORE COURSE
MB-C402 INDUSTRIAL MICROBIOLOGY

Course Objectives: This course elaborates on various processes and instruments used in Industrial Microbiology. It deals with different type of industrially important microorganisms their growth and preservation methods and their application in different processes related to industrial and food microbiology.

Course Level Learning Outcomes: Upon successful completion of the course, the learner will be able to-

CO1: Comprehend the theoretical and practical understanding of Designing and application, Principles of biofermentation

CO2: Know how to Isolate, Maintain, Preserve & improve industrial strains, understand the rationale in medium formulation & design for microbial fermentation, sterilization of instrument medium and air.

CO3: Know process of downstream processing for purifying the desired product from fermentation broth.

CO4: Student will learn basic aspects of industrial production

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO1	3	-	1	2	3	-	-	1	1	2	1	2	-	-	1	1
CO2	3	1	1	2	3	-	-	1	1	2	1	2	-	-	1	1
CO3	3	-	1	1	3	-	-	1	1	3	1	2	-	1	1	2
CO4	3	-	1	1	3	-	-	1	1	3	1	3	-	1	1	2

M.SC MICROBIOLOGY III SEMESTER
CORE COURSE
MB-C402INDUSTRIAL MICROBIOLOGY
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

TOPIC	TEACHING HOURS
UNIT –I **Biofermantation:** Designing and application; Principles of biofermentation, monitoring and control of parameters (pH, oxygen, agitation, temperature, foam etc.), batch & continuous. computer control of fermentation process.	**15**
UNIT-II Isolation, Maintenance, Preservation & improvement of industrial strains, The isolation, preservation and improvement of industrially important and useful microorganisms. Industrial fermentation- typical media, media formulation, water, energy and carbon sources, nitrogen sources, minerals, vitamin sources, nutrient recycle, buffers, precursors and metabolic regulators, oxygen requirement.	**15**
Unit III **Downstream Processing:** Filtration of fermentation broths, ultracentrifugation, recovery of biological products by distillation, superficial fluid extraction.	**15**
Unit IV **Production aspects:** Microbial strains, substrates, strain improvement, flow diagrams, product optimization, and applications of industrial alcohol (ethanol and butanol), amino acids (lysine, phenylalanine, tryptophan), antibiotics (cephalosporins, tetracyclines, polyenes), enzymes and immobilized enzymes, SCP, microbial polyesters, biosurfactants.	**15**

Suggested Books:

1. Solid State fermentation in Biotechnology by Pandey.
2. Industrial Microbiology by Waiter.
3. Fermentation Microbiology and Biotechnology by Mansi.
4. Industrial Microbiology by Patel.
5. Biotechnology: A text book of Industrial Microbiology by Greger
6. Principles of Fermentation technology by Whitaker.
7. Industrial Microbiology by Prescot& Dunn.
8. Microbial Technology by J.H. Peppler& D. Perlman.
9. Industrial Microbiology by L.E.Casida.
10. Industrial Microbiology by B.M. Miller &W.Litsky.
11. Economic Microbiology by Rose,
12. Advances in Applied Microbiology by Ed.Perlman, Series of volumes.

M.SC MICROBIOLOGY III SEMESTER
ELECTIVE COURSE
MB-E403ENVIRONMENTAL MICROBIOLOGY
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

Course Objectives: The main objective of this course is to impart the basic and advance knowledge about the microbial communities inhabiting in diverse environments, their role in environment and ecosystem wellness and interaction with various type of pollutants. The learner will be acquainted with the concepts of aquatic microbiology, aero microbiology, use of microbial population in microbial waste recycling and bioremediation, rumen microbiology and other related topics.

Course Level Learning Outcomes: Upon successful completion of the course, the learner will be able to-

CO1: Explain various concepts of Microbial Ecology and describe role of microorganism in recycling of elements

CO2: Student will be able to describe the diverse microbial habitats such as soil, water, air and animal

CO3: The students will gain knowledge about microbial diversity in extreme environments.

CO4: Describe the role of microbes in solid and liquid waste management, gaining knowledge of various methods employed in sewage treatment and solid waste treatment.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	-	-	1	1	-	-	-	2	1	1	1	-	2	-	1
CO2	-	-	-	-	1	-	-	-	-	-	-	-	-	1	-	1
CO3	-	-	-	-	1	-	-	-	-	-	-	-	-	1	2	1
CO4	1	-	-	1	1	-	-	1	1	1	1	1	-	2	2	1

M.SC MICROBIOLOGY III SEMESTER
ELECTIVE COURSE
MB-E403ENVIRONMENTAL MICROBIOLOGY
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

TOPIC	TEACHING HOURS
UNIT –I Microbial Ecology: Basic concept, types of microbial habitats, factors affecting microbial population; microbial interactions; competition, Amenesalism, parasitism, mutualism, commensalisms, synergism; Biogeochemical cycles: Carbon, Nitrogen, Phosphorous and Sulphur Cycle; Conservation and management of microbial diversity.	**15**
Unit II **Microbial diversity in normal environments:** Diversity of microbes in terrestrial (agricultural and desert soils), aquatic (fresh water and marine), atmospheric (stratosphere) and animal (cattle, termites, pests such as cockroach and nematodes, and human being) and their potential applications	**15**
UNIT-III **Microbial diversity in extreme environments:** Occurrence, diversity, adaptations and potential applications of oligotrophs, thermophiles, psychrophiles, barophiles, organic solvent and radiation tolerants, metallophiles, acidophiles, alkaliphiles and halophiles	**15**
UNIT IV Waste treatment: Wastes: types, solid and liquid wastes, treatments: physical, chemical and biological, aerobic and anaerobic, liquid waste treatment: trickling activated sludge, attached films, oxidation ponds and ditches; solid waste treatment. Sccharification, composting.	**15**

Suggested Books:

1. Extremophiles by B.N.Johri, Springer Verlog, New York.
2. Microbial Diversity by D.Cdwd, Academic press.
3. Manual at Environmental Microbiology, 2nd edition, by C.J. Hurst, ASM Press.
4. Microbial Ecology: Fundamentals and Applications, Atlas, RM &Barta, R.
5. Aerobiology, 1997, by Tilak.
6. Environmental Microbiology by Ralph Mitechell.
7. Bioremediation principles by Eweis.
8. Techniques in Microbial Ecology by Buruage.
9. Environmental Microbiology, 1981, by W.P. Grant and P.E. Long

M.SC MICROBIOLOGY III SEMESTER
ELECTIVE COURSE
MB-E404FOOD AND DAIRY MICROBIOLOGY
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

Course Objectives: The students will be familiarized with the apparatus and equipment used in a microbiology laboratory, how to maintain aseptic conditions in microbiological experiments. They will learn to prepare culture media, isolate and culture bacteria and fungi and to extract nematodes. They will learn to study the general morphological features of different microorganisms.

Course Level Learning Outcomes: Upon successful completion of the course, students will have the knowledge and skills to:

CO1: Student will have knowledge of Microorganisms important in food microbiology & Taxonomical classification of microbes associated with food products

CO2: Are able to understand different intrinsic and extrinsic factors responsible for food spoilage.

CO3: Are able to describe the role of microorganisms in the production of food

CO4: Are able to identify the role of microorganisms in the causation of the diseases and how to protect against food-borne pathogens.

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO1	3	-	1	2	3	-	-	1	1	2	1	2	-	-	1	1
CO2	3	1	1	2	3	-	-	1	1	2	1	2	-	-	1	1
CO3	3	-	1	1	3	-	-	1	1	3	1	2	-	1	1	2
CO4	3	-	1	1	3	-	-	1	1	3	1	3	-	1	1	2

M.SC MICROBIOLOGY III SEMESTER
ELECTIVE COURSE
MB-E404FOOD AND DAIRY MICROBIOLOGY
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

TOPIC	TEACHING HOURS
Unit I: Microorganisms important in food microbiology: Taxonomical classification of microbes associated with food products, their phenotypic and biochemical identification. Food associated molds, yeasts, yeast-like fungi and bacteria. Microbiome of food material	**15**
Unit II: **Microbiology of foods:** Microbial habitat of specific food materials, adaptations and changes in microbiome of vegetables, fruits, milk, fermented and non-fermented milk products, fresh meats, poultry and non-dairy fermented foods. **Microbial spoilage of foods:** Types and causes of spoilage of cereals and cereals products, spoilage of vegetables and fruits, spoilage of meat and meat products, spoilage of fish and other sea foods, spoilage of eggs and other poultry products, spoilage of milk and milk products. Study of microorganisms responsible for spoilage and microbial succession during spoilage. Brief insights into chemical and physical spoilage of foods. **Food preservation:** General principles of food preservation, various classical, physical, chemical, and biological methods of preservation. New developments in food preservation techniques. Analysis of practical implementation of such techniques.	**15**
Unit III: **Fermentation processes:** Production of fermented milk and milk products, plant-based products, fish products, meat products and nutraceuticals. Manufacture of starter cultures from lab to pilot scale. Batch submerged and solid-state fermentation of foods. **Food beverages and enzymes**: Concept of human microbiome, probiotics and prebiotics. Insight into health benefits of fermented milk products. Understanding benefits of tradition and non-traditional fermented foods. Introduction to the concept of bioactive compounds and brief study of such compounds from fermented foods including malt beverages, wines, distilled liquors and vinegar.	**15**
Unit IV: **Food-borne diseases:** Food borne infections including bacterial, viral and fungal infections. Study of infections due to food borne parasites. In depth study of various types and causes of food intoxication. Summary of prevention of microbial food infections. Identification and first aid for specific types of food infections.	**15**

Suggested Books:

1. Food Microbiology by W.C. Frazier, D.C. Westhoff , K.N. Vanitha. 5 th edition. McGraw Hill Education. 2013.
2. Modern Food Microbiology by J.M. Jay, M.J. Loessner, D.A. Golden. 7 th edition. Springer. 2006.
3. Fundamental Food Microbiology by B. Rayand A. Bhunia. 5th edition. CRC press. 2013.
4. Food Microbiology by M. R. Adams, M. O. Moss, P. McClure. 4 th edition. Royal Society of Chemistry. 2015.
5. Food Microbiology: Fundamentals and Frontiers by M. P. Doyle, L. R. Beuchat. 3 rd edition. ASM press. 2007.
6. Food Microbiology: An Introduction by T. Montville, K. Matthews, K.Kniel. 4 th edition. ASM press. 2017.

M.SC MICROBIOLOGY III SEMESTER
ELECTIVE COURSE
MB-E405AGRICULTURAL MICROBIOLOGY
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

Course Objectives: The main objective of this course is to impart the basic and advance knowledge about microbiota of soil, biological nitrogen-fixation, plant diseases & their control and new strategies & biotechnology in agriculture

Course Level Learning Outcomes: Upon successful completion of the course, students will have the knowledge and skills to:

CO1: Describe microbiota of soil, relationship between soil microorganisms & higher plants and their role in Organic matter decomposition

CO2: Student will have knowledge of Chemical transformation by microbes and mechanism of biological nitrogen-fixation

CO3: Explain causative agents, symptoms & control of important, fungal, bacterial & viral diseases in plants

CO4: Students will be able to evaluate new strategies & biotechnology in agriculture

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO1	2	1	1	-	2	-	-	1	2	2	2	2	1	2	-	2
CO2	2	-	-	-	2	-	-	-	1	-	1	2	-	-	-	1
CO3	2	-	-	-	2	-	-	-	1	-	1	2	-	-	-	1
CO4	2	-	-	-	2	-	-	-	1	-	1	2	-	-	-	1

M.SC MICROBIOLOGY III SEMESTER
ELECTIVE COURSE
MB-E405AGRICULTURAL MICROBIOLOGY
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

TOPIC	TEACHING HOURS
UNIT –I Microbiota of soil, inter-relationship between soil microorganisms & higher plants. Microbial products influencing plant growth. Organic matter decomposition: Degradation of plant residues, humus, mineralization & immobilization process, soil sickness, composting, vermin-composting, green manure, rhizosphere& phylosphere, biogas, biodegradation of pests & pollutants, biofertilizers	**15**
UNIT-II Biological nitrogen-fixation: The range of nitrogen fixing organisms; mechanism of nitrogen fixation (biochemistry of nitrogenase); genetics of nitrogen-fixation. Rhizobium-Legume Association; Symplasmids, N2 fixation by non-leguminous plants. Chemical transformation by microbes: Organic matter decomposition, nutrient mineralization and immobilization; transformation of carbon and carbon compounds.	**15**
UNIT-III Plant diseases & their control: Causative agents, symptoms & control of important, fungal, bacterial & viral diseases of cereal crops, fruits & vegetables, Bacterial- Citrus canker. Fungal- ergot of bajra and rot of sugarcane. Viral- viral diseases of potato.	**15**
UNIT IV New strategies & Biotechnology in Agriculture: The new green revolution, frostcontrol biotechnology, tolerance of herbicides, gene protection technology, biopesticides, bioconversion. patents, tissue culture	**15**

Suggested Books:

1. Agricultural Microbiology by G.Rangaswamy and Bagyaraj, Prentice Hall India.
2. Bio-fertilizers in Agriculture and Forestry, by N.S. SubbaRao.
3. Soil Microbiology and Plant Growth, by N.S. SubbaRao.
4. Sharma, P.D. (2016). Plant Pathology, Rastogi publications
5. Rao, N.S.S. (2015). Soil Microbiology. Oxford & IBH Publishing Co., New Delhi.
6. Jeffery C. Pommerville (2014). Alcamo's Fundamental Microbiology, Jones pub.
7. Ghulam Hassan Dar (2010).Soil Microbiology and Biochemistry
8. Agrios G. N. 2005. Plant Pathology. 5th Edition, Academic Press, San Diego.
9. Christon J. H. 2001. A Manual of Environmental Microbiology. ASM Publications.
10. Forster C. F. & John DA 2000. Environmental Biotechnology. Ellis Horwood Ltd. Publication.

M.SC MICROBIOLOGY III SEMESTER
ELECTIVE COURSE
MB-E406PLANT PATHOLOGY
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

Course Objectives: The objectives of this course are to provide basic understanding of the Concepts and physiology of plant diseases, Biochemical basis of plant diseases, Principles of plant disease control, Molecular diagnosis and transgenic approach for plant protection.

Course Level Learning Outcomes: Upon successful completion of the course, students will have the knowledge and skills to-

CO1: Student will able to understand concept of Causes of disease, pathogenesis, pathogenesis in relation to environment, effect of microbial infections on plant

CO2: Describe Biochemical and Genetic basis of plant diseases

CO3: Student will be able to explain Principles of plant disease control, physical and chemical methods of disease control

CO4: Student will be to learn the use of Molecular diagnosis, transgenic approach for plant protection, application of molecular diagnosis for disease forecasting.

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO1	2	-	-	1	1	-	1	-	2	1	1	1	-	2	1	1
CO2	-	-	-	-	1	-	1	-	-	-	-	-	-	1	2	1
CO3	-	-	-	-	1	-	1	-	-	-	-	-	-	1	2	1
CO4	1	-	-	1	1	-	1	1	1	1	1	1	-	2	2	1

M.SC MICROBIOLOGY III SEMESTER
ELECTIVE COURSE
MB-E406PLANT PATHOLOGY
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

TOPIC	TEACHING HOURS
UNIT I: Concepts and physiology of plant diseases: Causes of disease, pathogenesis, pathogenesis in relation to environment, effect of microbial infections on plant physiology, photosynthesis, respiration, transpiration, translocation.	**15**
UNIT II: Biochemical basis of plant diseases: Enzymes and toxins in plant diseases, phytoalexins. Some important plant diseases and their etiological studies: Crown gall, symptoms of viral diseases and their control, diseases of some important cereals, vegetables and crops. Genetic basis of plant diseases: Genetics of host-pathogen interactions, resistance genes, resistance mechanisms in plants.	**15**
UNIT III: Disease control: Principles of plant disease control, physical and chemical methods of disease control, biocontrol, biocontrol agents - concepts and practices, fungal agents, Trichoderma as biocontrol agent, biocontrol agents – uses and practical constraints.	**15**
UNIT VII Molecular approach: Molecular diagnosis, transgenic approach for plant protection, futuristic vision of molecular diagnosis, applications and constraints. : Disease forecasting: History and important milestones in disease control, disease forecasting and its relevance in Indian farming.	**15**

Suggested Books:

1. Plant Pathology by G. N. Agrios. 5 th edition. Academic Press. 2005
2. Plant Pathology by R.S. Mehrotra, and A. Aggarwal, 3rd edition. Tata McGraw Hill. 2017
3. Bacterial plant pathology: cell and molecular aspects by D. C. Sigee. Cambridge University Press.1993.
4. Molecular plant pathology by M. Dickinson. BIOS Scientific Publishers, London. 2003.
5. The essentials of Viruses, Vectors and Plant diseases by A.N. Basu& B.K. Giri. Wiley Eastern Limited.1993.
6. Biocontrol of Plant Diseases (Vol. I) by K.G. Mukerji and K.L.Garg. CRC Press Inc.,USA.1988.
7. Molecular Biology of Filamentous Fungi by U. Stahl and P. Tudzyski. VCH Verlagsgesellschaft mbH. 1992. Facilitating the achi

M.SC MICROBIOLOGY I SEMESTER
CORE COURSE
MB- 406 PRACTICAL
(TOTAL CREDIT -04, END SEMESTER MARKS -100)

CO1. To understand the quality of water using BOD and COD and to determine the potability of water sample

CO2. To provide practical knowledge and skill in the isolation of organisms from contaminated foods

CO3. To acquire hands-on training for the production of fermented products, organic acid, enzymes

CO4. To know the importance of biofertilizers and biopesticides

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO1	2	2	-	1	1	2	1	-	2	1	1	1	-	2	1	1
CO2	-	2	-	-	1	2	1	-	-	-	-	-	-	1	2	1
CO3	-	2	-	-	1	2	1	-	-	-	-	-	-	1	2	1
CO4	1	2	-	1	1	2	1	1	1	1	1	1	-	2	2	1

M.SC MICROBIOLOGY I SEMESTER
CORE COURSE
MB-406 PRACTICAL
(TOTAL CREDIT -04, END SEMESTER MARKS -100)

Experiment No. 1
Identification of microbial flora of the mouth-saliva
Experiment No. 2
Identification of microorganisms of the upper respiratory tract- II (Nasopharynx)
Experiment No. 3
Determination of quality of a milk sample by methylene blue reductase test
Experiment No. 4
Production of Ethanol by Immobilized Bakery Yeasts (*Saccharomyces cerevisiae*)
Experiment No. 5
Isolation of antibiotic-producing microorganisms from the soil
Experiment No. 6
Determination of Biochemical oxygen demand (BOD) of water
Experiment No. 7
Determination of Biochemical oxygen demand (COD) of water
Experiment No. 8
Determination of total bacterial population by Standard Plate Count Technique
Experiment No. 9
Identification and microbial examination of food
Experiment No. 10
Production of spawn for white button mushroom (*Agaricus bisporus*)
Experiment No. 11
To understand the principle and process of antibiotic sensitivity (Kirby-Bauer method) in bacteria using minimal inhibitory concentration (MIC) of an antibiotic

Dr. B. R. Ambedkar University, Agra

(Formerly: Agra University, AGRA)

Date: 17-09-2022

Meeting of the Board of Studies/ Academic Committee for P.G. Diploma in Yoga Education (PGDYE-One Year Course: Two Semester), Master in Physical Education & Sports Sciences (MPES-Two Year: Four Semesters) and B.A. in Yoga (BAY-Three Years: Six Semesters) and M.A. in Yoga (MAY- Two Years: Four Semesters) held on 17-09-2022 at 11.00am in the Department of Library & Information Science, Paliwal Park, Dr. B.R.A. University, Agra.

The Following members were present in the meeting –

1. Prof. U.C. Sharma (Dean Arts)
2. Dr. Akhilesh Chand Saxena (Convenor)
3. Dr. Dhanajay Singh, Assistant Professor, R.B. S. College, Agra (Subject Expert)
4. Dr. Sheeldhar Dubey, Associate Professor, PDDU College, Lucknow (Subject Expert)
5. Dr. S. N. Singh, Professsor, S.D. PG College, Muzaffarnagar (Subject Expert)
6. Dr. Ram Ji Mishra, Assistant Professor, Patanjali University (Subject Expert)

MINUTES

1. The Committee confirms the minutes of previous meeting with appreciation.
2. The syllabus as per CBCS of P.G. Diploma in Yoga Education (PGDYE) thoroughly studied by the committee and passed with warm appreciation. The theory subjects and practical of this course are given in the Enclosure-1.
3. The syllabus as per Two Year Course having four semester on the basis of CBCS for Master in Physical Education & Sports Sciences (MPES) thoroughly studied by the committee and passed with positive appreciation. The details of theory subjects and practical of this course are given in the Encloser – 2.
4. The syllabus as per three Year Course having six semester on the basis of CBCS for B.A in Yoga (BAY) thoroughly studied by the committee and passed with appreciation. The details of theory subjects and practical of this course are given in Encloser-3.
5. The syllabus as per two Year Course having four semester on the basis of CBCS for M.A. in Yoga (MAY) thoroughly studied by the committee and passed with appreciation. The details of theory subjects and practical of this course are given in Encloser-4.
6. The committee also submitted the list of examiners for the M.A. in Yoga (MAY) course and for other above three courses lists were already submitted in the previous meeting held on 29/04/2022.
7. The committee has discussed and decided that the list of examiners will be approved in the further meeting.
8. The meeting ends with the vote of thanks.

Note : Committee has decided to amend the above courses as per National Education Policy (NEP), if it required.

Dr.B.R.AmbedkarUniversity,Agra
(Formerly:Agra University, AGRA)

CURRICULUMFOR

POST GRADUATE DIPLOMA IN YOGA EDUCATION(PGDYEd)

PROGRAMMEONEYEAR-(TWOSEMESTERS)

ORDINANCE,REGULATIONS ANDSYLLABUSFORPGDYEd.(CBCS)

Preamble

ThetraditionofYogahasalwaysbeenpassedonindividuallyfromteachertostudentthrough oral teaching and practical demonstration. The formal techniques that are now known asYoga are, therefore, based on the collective experiences of many individuals over manythousandsofyears.Theparticular mannerin whichthe techniquesaretaught andpracticed todaydepends on theapproachpassed down in thelineof teachers supportingtheindividualpractitioner. Yoga is essentially a spiritual discipline based on an extremely subtle science,whichfocuses on establishingharmonybetween mind,body; thoughtand action;restraint andfulfillment;harmonybetweenmanandnatureandaholisticapproachtohealthand wellbeing.

Inadditiontothis,Yogaisbecomingpopulardaybydayandhasbecomeawavewhichis sweeping across the globe. In this course we introduce yoga as a science of**Holistic Living**and not merely as yoga postures. During the course the student is taught the concepts of Yoga for thetreatmentandprevention ofvariouspsychosomatic ailments.Thiscourselooks attraining theenthusiaststobecomeYogatherapistsothattheycouldteachyogaunderthesupervisionofadoctor for health andhealing.

1. Titleof thePrograмme

Theprogrammeshallbecalled"**Post Graduate Diploma in Yoga Education"(PGDYEd)**
Tomakethepeopleawareofthetherapeuticand preventivevalueof Yoga.

1. To bringpeaceandharmonyinthe societyatlargebyintroducingthe Yogicwayoflife.
2. To create therapists of high caliber to make the society free from stress and lifestylerelated diseases.

1.Eligibility

A) CandidateseekingadmissionPost Graduate Diploma in Yoga Education(PGDYEd)programmustbegraduate with 50 % fromUGC recognized institution.

B) Theprovisionofseatsandtherelaxationinqualifyingmarksfor SC/ST/OBCandothercategories shallbeaspertherulesofthecentralgovernment/stategovernment.Whicheverisapplicable

2. Post Graduate Diploma in Yoga Education"(PGDYEd)Degree: Thecandidatesshall havesubsequentlyundergonetheprescribedcourseofstudyin the universitydepartment or a college affiliated to his University for a period of not less than twoacademic years, passed the examinations prescribed and fulfilled such conditions as have been prescribedthereforPost Graduate Diploma in Yoga Education"(PGDYEd).

3.Duration:

The PGDYEd.program shall be of duration of one academic years, that is,two semesters. However,
thestudentsshallbepermittedtocompletetheprogramrequirementswithinamaximumoftwoye arsfromthedateofadmission.

4.TheCBCSSystem:

All Programs shall run on Choice Based Credit System (CBCS). It is an instructional package developed tosuit the need of students, to keep pace with the developments in higher education and the quality assuranceexpectedofitinthelightofliberalizationandglobalizationinhighereducation.

5. Courses

Thetermcourseusuallyrefereed to, as'papers'isa component of aprogram.All coursesneednot carrythesame weight. The courses should define learning objectives and learning outcomes. A course may bedesigned to comprise Lecturer/tutorials/ laboratory work/fieldwork/Outreach activity (Educational Toursactivities)/ project work/vocational training/viva/seminars/term papers/assignments/ presentations/self-studyetc.oracombinationofsomeofthese.

6.CoursesofProgram:

ThePGDYEdProgramconsistsofanumberofcourses,theterm'Course'appliedtoindicatealogical part ofsubjectmatter of the Programand is invariably equivalentto the subject matter of a "paper" in theconventionalsense.Thefollowingarethevariouscategoriesofcoursessuggestedforthe PGDYEdProgram.

7.Semesters:

An academic year is divided in to two semesters; each semester will consist of 17-20 weeks of academicwork equivalent to 100 actual teaching days excluding examination days. The odd semester may bescheduled fromJuly to December and even semester from January to June.Theinstitutionshallworkforaminimumof36workinghoursinaweek(fiveorsixdaysaweek).

8.WorkingDay:

Thereshallbeatleast200workingdaysin ayearexclusiveofadmissionandexaminationprocessesetc.

9.Credits:

Theterm'Credit'referstoaunitybywhichtheprogramis measured. Itdeterminesthenumberofhours ofinstructions required per week. One credit is equivalent to one hour of teaching (lecture or tutorial) or oneand half/twohoursofpracticalwork/fieldworkperweek.Theterm'Credit'refersto the weightgiventoacourse. Usually in relation to the instructional hours assigned to it. The total minimum credits, required forcompletingaPGDYEdProgramis52creditsandforeachsemester26credits.

10.Examinations:

i. Thereshallbeexaminationsattheendofeachsemester,forfirstsemesterinthemonthofDecember/January: for second semester in the month of May/June. A Candidate who does not pass theexaminationinanySubjectsshallbepermittedtoappearinsuchfailedsubjectsinthesubsequentexaminationstobeheldinNovember/DecemberorMay/June.

ii. A candidate should get enrolled/registered for thefirst semester examination. If enrollment/registration isnotpossibleowingtoshortageofattendancebeyondconditionlimit/rulesprescribedORbelatedjoiningORon medical grounds, such candidates are not permitted to proceed to the next semester. Such candidatesshall redo the semester in the subsequent term of the semester as a regular student; however, a student offirst semester shall be admitted in the second semester, if he/she have successfully kept the term in firstsemester.

11.Conditions:

Student must have 75% of attendance in each course for appearing the examination. Students who have74%to65%ofattendanceshallapplyforconditionintheprescribedformwiththeprescribedfee.Studentswhohave64%to50%ofattendanceshallapplyforconditioninprescribedformwiththe

prescribedfeealongwiththeMedicalCertificate.Studentwhoparticipateinsportscompetition affiliatedbyIOAshallapplybeconsideredinexaminationwiththepermissionofheadofthedepartment.Studentswhohavebelow50%ofattendancearenoteligibletoappearfortheexamination.

12.PatternofQuestionPapers:

QuestionPapersshallhavefivequestionscorrespondingtofourunitsofeachtheorycourse.

PGDYEd.:FormatofQuestionsPaper For 4Units

Eachquestionpapershallhavefivequestions.Thepatternwillbeasfollows:

QuestionNo.	Description	Marks
1	**Answerindetail(LongQuestion)Or** Answerindetail(LongQuestion)(FormUnit1)	15
2	**Answerindetail(LongQuestion)Or** Answerindetail(LongQuestion)(FormUnit2)	15
3	**Answerindetail(LongQuestion)Or** Answerindetail(LongQuestion)(FormUnit3)	15
4	**Writeshortnotes:anytwooutoffour (FormUnit4)**	15
5	M.C.Q.TypeQuestions(15outof15Question) (fromeachunit)	15
Total		75

13. Evaluation:

Theperformanceofastudentineachcourseisevaluatedintermsofpercentageofmarkswithap rovisionforconversiontogradepoint.Evaluationforeachcourseshallbedonebyacontinuous internal assessment (CIA) by the concerned course teacher as well as by end semester examination
andwillbeconsolidatingattheendofcourse.Thecomponentsforcontinuousinternalassessm entare:

OneTest	**10 Marks**
Seminar/Quiz	**5 Marks**
Assignments	**5 Marks**
Attendan ce	**5 Marks**
Total	**25 Marks**

Attendance shall be taken as a component of continuous assessment, although the students should haveminimum 75% attendance in each course. In addition to continuous evaluation component, the endsemesterexamination,whichwillbewrittentypeexaminationof
atleast1hoursduration,wouldalsoforman integral component of the evaluation. The ratio of marks to be allotted to continuous internalassessment and to end semester examination is 25:75. The evaluation of practical work, whereverapplicable, will also be based on continuous internalassessment and on an end-semester practicalexamination.

14. MinimumPassingStandard:

The minimum passing standard for CIA (Continuous Internal Assessment) and External Examinationsshall be40%,i.e.10marksoutof25marks and30marksoutof75marksrespectivelyfortheorycourse.The minimum passing for both CIA & external examination shall be 40%, i.e. 10 marks out of 25 and 30marksoutof 75 Marksforthepracticalcourses.

15. Awardofthe PGDYEd.Degree:

A candidate shall be eligible for the award of the degree of the PGDYEdOnly if he/she has earned theminimumrequiredcredit.

16. **Assessment andEvaluations:TOTAL MARKINGSYSTEM**

[SEMESTER	THRORETICAL	PRACTICAL	CREDITS
Semester–1	400	200	26
Semester–2	400	200	26
Total	800	400	52

I. Eachcoursewillbeassessedonthebasisof100marks. Themarkswouldbedividedbetweeninternalandexternalassessment.

II. Thereshallbeoneendsemesterexternalexaminationforeachcourseineverysemesterconsistingof 75%(75marks)weightintheoryand75%(75marks)inpracticalcourses.

III. Each

Theorycourseshallhaveinternalassessmentof25%weightageonthe

following Internalwrittentest-10%(10marks)Attendance-

05%(5marks)

Classparticipationinassignments-05%(5marks)Presentations(Seminars)/quizzesetc.-05%(5marks)

Total 25marks

IV. EachPracticalCourseshallhaveinternalassessmentof

25%weightageonthefollowing OneTest10marksProject10marks

Attendance05marks

Total 25marks

V. Everystudentwillberequiredtopasstheexternalexaminationandinternalassessmentseparatelyineachcourse.

VI. The minimum passing standard will be 40% for the external and internal component of each theorycourse, i.e. 30 marks out of 75 and 10 marks out of 25.In practical minimum passing standard will be40%

fortheexternalexamandinternalassessmentforeachpracticalcourse.

VII. Attendanceshallbetaken asacomponentforcontinuousassessment,althoughthestudentsshouldputinminimum of 75% attendance in each course. In addition to continuous evaluation component, the endsemester examination, which will be written type examinations of at least 1 hours duration, would alsoform an integral component of the evaluation. The ratio of marks to be allotted to continuous internalassessmentandtoendsemester,examinationis25:75intheory& 25:75 inpractical.

VIII.(A) The grades for each course would be decided on the basis of the percentage of marks obtained intheend-semesterexternalandinternalexaminationsasperthefollowingtable:

Percentage	GradePoint	Grade	Description	Classification of finalresult
85&above	8.5-10.0	O	Outstanding	FirstclasswithDistinction
70-84.99	7.0-8.49	A+	Excellent	
60-69.99	6.0-6.99	A	VeryGood	FirstClass
55-59.99	5.5-5.99	B+	Good	HigherSecondClass
48-54.99	4.8-5.49	B	Fair	SecondClass
40-47.99	4.0-4.79	C	Average	PassClass
Below40	0.0	D	Fail/Dropped	Dropped

IX. Thesemestergradepoint average(SGPA)will becalculatedasaweightedaverageofall thegradepointofthesemestercourses.ThatisSemestergradepointaverage(SGPA)=(sumofgradepointsofallsixcoursesofthesemester)/totalcreditofthesemesterasperexamplegivenbelow:

CourseNo	Credit	Marks out of100(%)	Grade	GradePoint	Credit Gradepoint
Course-1	5	65	A	6.5	26
Course-2	5	60	A	6.0	24
Course-3	5	62	A	6.2	24.8
Course-4	5	57	B+	5.7	22.8
Course-5	3	55	B+	5.5	22
Course-6	3	72	O	7.2	28.2
Total	26				147.8

Examples:Conversionofmarksintogradepoints

65=60+5=6.0+5x(0.99/9.99)=6.0+5x0.1=6.0+0.5=6.5

57=55+2=5.5+2x(0.49/4.99)=5.5+2x0.1=5.5+0.2=5.7

72=70+2=7.0+2x(1.49/14.99)=7.0+2x0.1=7.0+0.2=7.2

X. SEMESTERGRADEPOINTAVERAGE(SGPA)=TotalCreditGradePoints=147.8/24=6.16SGPASem.I=

6.16 SGPA Sem. II

=

5.63SGPASem.III=6

.01SGPASem.IV=5.5

0

TotalSGPA=23.30

CumulativeGradePointAverage(CGPA)=23.30

4=5.82CGPA=5.82Grade=B+Class=HigherSecondCla

ssGPAX10=Percentagee.g.5.82X10=58.2%

Note:

(1) SGPAiscalculatedonlyifthecandidatepassesinallthecoursesi.e.getminimumCgradeinallthecourses.

(2) CGPAiscalculatedonlywhenthecandidatepassesinallthecoursesofallthesemesters.

XI. Thecumulativegradepointaveragewillbecalculatedas theaverageoftheSGPAofallthefoursemesters,asshownabove.

XII. Forthawardoftheclass,CGPAshallbecalculatedonthebasisof:

(a) MarksofEndSemesterExternalExaminationAnd

(b)TotalMarksobtained(MarksofEndSemesterExternalExamination

+MarksofInternalAssessment)foreachcourse.ThefinalClassforM.A.Y. Degreeshallbe awardedonthebasisoflowestCGPA(marks)of(a)&(b)ofone tofourthsemesterexaminations.

17.ConfermentofthePGDYEd.Degree:

(i)Acandidateshallbeeligiblefortheconfermentoftheegreeof PGDYEdonlyifhe/shehasearnedtheminimumrequiredcreditsfortheprogramprescribedtherefore(i.e.52Credits).

18.EndSemesterExamination:

(i) TheUniversityshallconductheexternalExaminationfortheSemester-I&II.Theinternalexaminationshallbeconductedbytheconcernedbepartments.

SCHEME OF EXAMINATIONS
POST GRADUATE DIPLOMA IN YOGA EDUCATION (PGDYEd)

SEMESTER–I

PART – A (THEORY)										
Paper No.	Paper Code	Name of Subjects	Max. Marks		Min. Pass Marks		Sessional Marks	Aggregate Pass Marks	Total Marks	Credits
			Theory	Practical/ Viva-voce	Theory/ Practical	Sessional				
I.	PGDY CC-101	Fundamentals of Yoga	75	-	30	10	25	40	100	5
II.	PGDY CC-102	Foundation & Practices of Hatha Yoga	75	-	30	10	25	40	100	5
III.	PGDY CC-103	Applied Anatomy and Physiology	75	-	30	10	25	40	100	5
IV.	PGDY CC-104	Naturopathy	75	-	30	10	25	40	100	5
								TOTAL	**400**	**20**
PART B PRACTICALS AND LESSON PLAN										
I.	PGDY PC-101	Yoga Practical-I	-	75	30	10	25	40	100	3
II.	PGDY PC-102	Naturopathy Practical	-	75	30	10	25	40	100	3
								TOTAL	**200**	**6**
								GRAND TOTAL	**600**	**26**

SCHEME OF EXAMINATIONS
POST GRADUATE DIPLOMA IN YOGA EDUCATION (PGDYEd)

SEMESTER–II

PART – A (THEORY)										
Paper No.	Paper Code	Name of Subjects	Max. Marks		Min. Pass Marks		Sessional Marks	Aggregate Pass Marks	Total Marks	Credits
			Theory	Practical/ Viva-voce	Theory/ Practical	Sessional				
I.	PGDY CC-201	Patanjali Yoga Sutra	75	-	30	10	25	40	100	5
II.	PGDY CC-202	Arham Yoga	75	-	30	10	25	40	100	5
III.	PGDY CC-203	Principles of Psychology and Counseling	75	-	30	10	25	40	100	5
IV.	PGDY CC-204	Alternate Therapy	75	-	30	10	25	40	100	5
								TOTAL	**400**	**20**
PART B: PRACTICAL AND LESSON PLAN										
I.	PGDY PC-201	Yoga Practical-II	-	75	30	10	25	40	100	3
II.	PGDY CP-202	Alternate Therapy Practical	-	75	30	10	25	40	100	3
								TOTAL	**200**	**6**
								GRAND TOTAL	**600**	**26**

SEMESTER–I

PAPER- I: FUNDAMENTALS OF YOGA

Subject Code: (PGDY CC-101)

UNIT – I

1. INTRODUCTION TO YOGA AND INDIAN PHILOSOPHY

1.1 Brief introduction to origin of Yoga, History and development of Yoga

1.2 Etymology and definitions of Yoga, Aim, Objectives and Misconceptions about Yoga, True Nature of Yoga

1.3 General introduction to Shad-darshana, Salient features of Indian Philosophy, Branches of Indian Philosophy (Astika and NastikaDarshanas)

1.4 General introduction to Prasthanatrayee and PurusharthaChatushtaya.

UNIT – II

2. BRIEF SURVEY OF YOGIC TRADITIONS – I

2.1 Brief introduction of Vedic Literture, Concept of Yoga in Veda

2.2 General Introduction to Upanishada, Concept of Yoga in Upanishada

2.3 General introduction to Bhagavadgita, Yoga in Bhagawadgita

2.4 Concept of Yoga in Yoga Vashishtha.

UNIT-III

3. BRIEF INTRODUCTION TO YOGA PARAMPARAS IN CONTEMPORARY TIMES

3.1 Life & message of Swami Vivekananda, ShriAurobindo,

3.2 Yoga Parampara of Sri T. Krishnamacharya, and Yogacharya B.K.S Iyengar& Swami DhirendraBhramhachary in the promotion of Yoga.

3.3 Yoga Parampara of Swami Shivanada, ShyamacharanLahiriMahashaya

3.4 Contribution of Sri Yogendraji, Swami Kuvalyananda

UNIT – IV

4. GENERAL INTRODUCTION TO SCHOOLS OF YOGA

4.1 **Jnana Yoga:** Meaning of Jñāna and Jñāna-yoga, Sadhana-chatushtaya, Means of Jñāna-yoga.

4.2 **Bhakti Yoga:** Meaning of Bhakti and Bhakti-yoga, Stages of Bhakti, Types of Bhakti, Means of Bhakti-yoga.

4.3 **Karma Yoga:** Meaning of Karma and Karma-yoga, Concept of Nishkama Karma, Inter relationship between Bhakti-yoga and Karma-yoga, Theory of Karma and Rebirth (Reincarnation).

4.4 **Raja Yoga:** Meaning, definition of Raja Yoga, Ashtanga Yoga, relationship between Hatha Yoga & Raja Yoga.

REFERENCE:

1. Gupta, S.N Das, (1963), "Indian Philosophy", ShriJainendra Press, New Delhi, ISBN-81-208-0412-0.
2. Anatharaman, T.N., (1996), "Ancient Yoga and Modern Science", Project of History of Indian Sciences Philosophy & Culture,-ISBN 8121507529
3. Sturgess, Stephen, (1996), "The Yoga Book", Watkins Publications, London, University of Michigan
4. Kumar, Dr. Kamakhya, (2008), "Super Science of Yoga", Standard Publications, New Delhi ISBN-8187471409
5. Dasgupta, S.N., (1924), "Yoga Philosophy",The May Flower Press, UK.
6. Jha, Gangadhar, (1894), "Yoga Sara Samgraha" --Bombay Theosophical Fund, TatvaVivechaka Press, Bombay

SEMESTER–I

PAPER- II: FOUNDATION & PRACTICES OF HATHA YOGA

Subject Code: (PGDY CC-102)

UNIT –I

1. **INTRODUCTION TO HATH YOGA**

1.1 Hathayoga: Philosophy, Origin, Definition, Objectives and Misconceptions.

1.2 Hathyoga: History and development, Brief Introduction to eminent Hatha Yogis of NathaParampara and their contribution to Yoga.

1.3 Time and Place, Dress Code & Environment for Hatha Yoga, Concept of Mitahara, Pathya and Apathya, SadhakaTatva, BadhakTatva, Hathsiddhilakshana (as per Hatha Yoga Pradipika).

1.4 Introduction of Asanas, Shatkarmas - Meaning, Definitions, Principles, Types, Technique, Precautions and Benefits. (as per Hatha Yoga Pradipika).

UNIT –II

2. **KUMBHAKA, MUDRAS, BANDHAS, NADANUSANDHANA (AS PER HATHA YOGA PRADIPIKA).**

2.1 Kumbhaka :- Meaning, definition, Types of Kumbhaka, Technique, Precautions & Benefits.

2.2 Mudras and Bandhas – Meaning, Definition, Technique, Precautions and Benefits.

2.3 Chakras, Kundalini and Nadis

2.4 Nadanusandhana andVarious types of Samadhis

UNIT-III

3. **INTRODUCTION OF GHERANDA SAMHITA**

3.1 Introduction and History ofGherandaSamhita

3.2 Concept of Ghatasth Yoga. Saptasadhana:-Shatkarma, Asanas, Mudra, Pratyahara, Pranayama, Dhyana, Samadhi.

3.3 Shatkarma- Meaning, Types (Dhauti, Basti, Neti, Trataka, Nauli and Kapalabhati) Technique, Precautions and Benefits.

3.4 Asanasand Mudras -Meaning, Definition Types, Technique, Precautions and Benefits.

UNIT –IV

4. **PRATYAHARA AND PRANAYAMAS (AS PER GHERANDA SAMHITA).**

4.1 Pratyahara – Meaning, Types, Technique, Precautions and Benefits.

4.2 Concept of Prana, Types of Prana and their functioning,,Pranayamas – Meaning and Definition, Types, Technique, Precautions and Benefits.

4.3 Dhayana- Meaning, Types, Technique, Precautions and Benefits.

4.4 Samadhi - Meaning, Types, Technique, Precautions and Benefits.

REFERENCE:

1. Digambarji, Swami (1998), "Hatha Pradipika of Svatmarama", - ISBN: 9788189485122, Publisher: Kaivalyadhama, SMYM Samiti, Lonavala - Pune.

2. Muktibodhananda, Swami (1998), "Hatha Yoga Pradipika" - Light on Hatha Yoga, - ISBN: 81-85787-38-7, Publisher: Yoga Publications Trust, Ganga Darshan, Munger, Bihar, India.

3. NiranjanandaSaraswati, Swami (2012), "GherendaSamhita" - ISBN : 9381620199, Publisher: Yoga Publications Trust, Ganga Darshan, Munger - Bihar, India.

4. NiranjanandaSaraswati, Swami (2009), "Prana and Pranayama", - ISBN: 978-81-86336-79-3, Publisher: Yoga Publications Trust, Ganga Darshan, Munger - Bihar, India.

5. Bhardwaj, Yogeshwar (2004), "Textbook of Yoga"- ISBN: 0143029657, Publisher:Penguin - India.

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SEMESTER–I

PAPER- III: APPLIED ANATOMY AND PHYSIOLOGY

Subject Code: (PGDY CC-103)

UNIT- I

1. GENERAL HUMAN ANATOMY AND PHYSIOLOGY

1.1 Introduction of Anatomy and Physiology, importance and need in field of yoga

1.2 Cell - Structure Composition, function and its types; Types of Tissues, their structure and functions; Brief introduction of different organs and systems of human body

1.3 Digestionsystem; Excretory System; Urinary System, (Structure and Functions in brief).

1.4 Effect of yogic practices on digestive and excretory system (asana, pranayama, mudra, bandha, kriyas and meditation)

UNIT- II

2. MUSCULO– SKELETAL SYSTEM

2.1 Skeletal system - Introduction, Composition of bone.

2.2 Classification and division of skeleton, Joints and their movements.

2.3 Muscles, their types and role.

2.4 Effect of yogic practices on muscular and skeletal system (asana, pranayama, mudra, bandha, kriyas and meditation).

UNIT-III

3. CARDIO RESPIRATORY SYSTEM

3.1 Structure and functions of Heart and Lungs, Cardiac Cycle, Cardiac Output, Stroke Volume.

3.2 Muscles and Mechanism of Respiration, Second Wind, Oxygen Debt.

3.3 Internal and External Respiration, Respiratory Volumes and Pulmonary Ventilation.

3.4Effect of yogic practices on cardio respiratory system (asana, pranayama, mudra, bandha, kriyas and meditation).

UNIT-IV

4. NERVOUS AND HORMONAL SYSTEM

4.1 Nervous System: Structural and Functional Divisions of Nervous System– PNS, ANS, and Sensory Motor Nervous System. Parts of Brain and their functions.Structure and Functions of Spinal Cord.

4.2 Endocrine Glands and Exocrine Glands. Structure and Functions of Adrenal, Pituitary, Pancreas and Thyroid Glands.

4.3 Introduction to Sense Organs: Eyes, Ears, Nose and Skin.

4.4 Effect of yogic practices on nervous and hormonal system (asana, pranayama, mudra, bandha, kriyas and meditation)

REFERENCES:

1. Coutter, H.D. (2001), "Anatomy of Hath Yoga" Published by Himalayan Institute India, Jhansi, Allahabad, ISBN-978-0-9797006-1-2.
2. Saraswati, S. (2009), "Yoga Nidra" Published by Yoga Publication Trust, Bihar, India (Reprint) ISBN-978-81-83787-12-1.
3. Maehle, G. (2008), "Ashtanga Yoga Practice & Philosophy" First Indian Edition Published by, New Age Books, New Delhi (Reprint), ISBN-978-81-78-22-329-2.
4. Karambelkar, P.V. (2011), "Patanjali Yoga Sutra" Published by Kawalyadham S.M.Y.M. Publications Pune, India. ISBN-81-89-415-17-2.
5. Martini, F.H. et al (2000), "Applications Manual for Essentials of Anatomy & Physiology" Second Edition by Prentice Hall Inc., U.S.A. ISBN-0-13-014662-5.
6. Chaurasia, B.D. (2014), "Human Anatomy" Vol.-1, Fourth Edition, CBS Publishers and Distributors, New Delhi. ISBN-81-239-1155-6.
7. Shiva, V.K. (2013), "Anatomy and Physiology" Sports Publication, New Delhi. ISBN-978-81-7879-761-8.
8. Moore, K.L. &Agur, A.M.R. (2002), "Essential Clinical Anatomy" Second Edition by Lippincott Williams & Wilkins, Philadelphia.
9. Sharma, J.P. (2002), "Essential Encyclopedia of Human Anatomy and Physiology, by KhelSahitya Kendra, New Delhi. ISBN-81-7824-296-5.
10. Kumar, R. (2012), "Anatomy and Exercise Physiology" Sports Publication, New Delhi. ISBN-978-81-7879-697-0.
11. Singh, H. (2013), Anatomy and Exercise Physiology KhelSahitya Kendra, New Delhi. ISBN-978-81-7824-690-4.

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SEMESTER–I
PAPER- IV: NATUROPATHY
Subject Code: (PGDY CC-104)

UNIT-I

1. INTRODUCTION TO NATURE CURE

1.1 Meaning, Definition and Fundamental Principles of Naturopathy
1.2 Historical background of Naturopathy (Indian & Western)
1.3 Law of Nature/ Philosophy of Nature Cure- Panchamahabhuta Theory
1.4 Foreign Matter Theory/ Toxemia

UNIT-II

2. FASTING AND DIETETICS

2.1 Definition, Introduction and Classification of Fasting
2.2 Difference between Fasting and Starvation, Hunger and Appetite
2.3 Hygienic auxiliaries during Fasting, Physiological effect of Fasting, Methods of Breaking the fast.
2.4 Diet according to Naturopathy and its Types.

UNIT-III

3. HYDROTHERAPY AND MUD THERAPY

3.1 Introduction, Definition, Brief History, General Principles of Hydrotherapy
3.2 Physical Properties of Water and Classification of Temperature
3.3 Different Hydriatic Measures, Therapeutic Effect of Hydriatic Application
3.4 Introduction to Mud Therapy, Classification of Mud for Therapeutic use, Method of Treatment of Mud, Therapeutic Effect of Mud Therapy.

UNIT-IV

4. MANAGEMENT OF VARIOUS DISEASES WITH NATUROPATHY

4.1 Management of Obesity and Diabetes
4.2 Management of Blood Pressure
4.3 Management of Asthma
4.4 Management of Artheritisand Back Pain

REFERENCES:

1. Bakhru H. K.,The Complete Handbook Of Nature Cure,Jaico Publishing House – Mumbai,ISBN13: 9788172242299
2. Prasoon, Prof. Shrikant, PanchaMahabhutatatwa and Sharira, HINDOOLOGY BOOKS, ISBN: 9788122310115
3. Shew, Joel, (1989) Handbook of Hydrotherapy Publisher: Society of Metaphysicians Ltd; New ed of 1844 ed edition (1 January 1989), ISBN-13: 978-1852288785
4. Kellogg,John Harvey,(2004) Rational Hydrotherapy: A Manual of the Physiological and Therapeutic Effects of Hydriatic Procedures, and the Technique of their Application in the Treatment of Disease. TEACH Services, Inc. ISBN-13: 978-1572582095
5. Indani, Ashish,(2013) Mud Therapy: Healing Through One of the Five Elements , B Jain Publishers Pvt Ltd , ISBN-13: 978-8131908457
6. Ehret, Arnold, (1971) Rational Fasting, Mass Market, Benedict Lust, ISBN-13: 978-0879040055
7. Herbert M., Shelton, (1974) Fasting for Renewal of Life ISBN-13: 978-0914532385
8. Shelton, Herbert M., (2013) The Science and Fine Art of Fasting,Martino Fine Books ISBN-13: 978-1614274483

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SEMESTER-I
Yoga Practical Syllabus (PART-B)
Subject Code: (PGDY PC-101)

B-1: SYLLABUS FOR YOGA PRACTICAL - I

1. ASANAS:
   a) **Surya Namaskara**
   b) **SukshamaVyayama-**PawanMuktasana Series I, II, III
   c) **Meditative Asanas:**Padmasan, Siddhasana, Swastikasana, ArdhaPadmasana, Vajrasana
   d) **Relaxation Asanas:**Shavasana, Makarasana, ShithilaTadasana, ShithilaDandasana, Shashank Asana
   e) **Supine Asanas:**Naukasana, Kandharasana, Pavanmuktasana, Ardhamatsyasana, AnandBalasana.
   f) **Prone Lying Asanas:**Bhujangasana, Shalabhasana, Dhanurasana, Hamsasana, Santolanasana
   g) **Inversions:**Sarvangasana, Vipareetkarani asana,
   h) **Sitting Asanas:**Paschimottanasana, ArdhaMatsyendrasana, ArdhaChandrasana, ArdhaUshtrasana, Simhasana, AkarnaDhanurasana, JanuShirshasana.
   i) **Standing Asanas:**Tadasana, Natarajasana, Garudasana, Vrikshasana.
   j) **Advanced Group Asanas:**PoornaMatsyasana, Padmasarvangasana, Karnpedasana, Suptvajrasana, PoornaBhujangasana, Koormasana, Vatayasana, DwihastaBhujasana, NiralambaPaschimottanasana, Ashtavakrasana

2. PRANAYAMA:

   NadiShodhan Pranayama, Surya Bheda Pranayama, Chandra Bheda Pranayama, Ujjayi, Sheetali, Seetkari, Bhastrika, Brahmari

3. BANDHAS & MUDRAS:

   Gyana Mudra , PanchaBhautik Mudras, Jalandhar Bandha, UddiyanBandha, Vipreetkarni Mudra, Shanmukhi Mudra, Manduki Mudra, Ashwini Mudra, Kaki Mudra, Bhujangini Mudra

4. SHATKARMA:

   (a) NETI: JalNeti, Sutra Neti
   (b) DHAUTI: KunjalKriya, AgnisarKriya

5. MEDITATION TECHNIQUE: OM Meditation

6. RELAXATION TECHNIQUE: Basics of Yoga Nidra, IRT (Instant Relaxation Technique

SEMESTER-I
Naturopathy Practical (PART-B)
Subject Code: (PGDY PC-102)

B-2: NATUROPATHYPRACTICAL

Naturopathy

1. Students should be introduced to various treatment procedures used in Naturopathy.
2. Hydrotherapy and Mud Therapy
   Demonstration of various therapeutic effects, procedure and treatments in Hydrotherapy and mud therapy during practical classes.
3. Management of Diseases like Diabetes, High Blood Pressure, Asthma, Back Pain through Naturopathy.
4. Practical Record should be Maintained.
5. The Vice-Voce shall be from the complete theory syllabus of naturopahy.

SEMESTER–II

PAPER- I: PATANJALI YOGA SUTRA

Subject Code: (PGDY CC-201)

UNIT – I

1. COMPONENTS OF SAMADHI PADA

1.1 Introduction of Maharishi Patanjali, Historical background of pantanjali yoga sutras

1.2 Concept of Chitta, ChittaVriti, ChittaBhumi

1.3 Concept of Abhyasa – Vairagya, Definition & Attribute of Ishwara, Concept of IshwaraPranidhana

1.4 Yogaantaraya, ChittaVikshepsahabhuh, ChittaPrasadhana, Meaning of Samadhi, Different types of Samadhi.

UNIT – II

2. ELEMENTS OF SADHANA PADA

2.1 Kriya Yoga, PanchaKlesha, Pratiprasava

2.2 Definition of Drashta&Drishya, Tritap

2.3 Karmashaya, Haan, Hanopaya

2.4 Introduction of Ashtanga Yoga, Description of Various Limbs.

UNIT – III

3. PSYCHIC POWERS OF VIBHUTI PADA

3.1 Samyama, attainment of various Vibhooti

3.2 Kayasampata (Physical Excellence)

3.3 Manojavitvam (Mental Excellence)

3.4 VivekKhyati (Knowledge of Discrimination)

UNIT – IV

4. SAMADHI & ITS TYPES

4.1 Types of Siddhis

4.2 Concept of Dharmamegh Samadhi

4.3 Brief introduction of Karma, Types of Karma, KarmaphalSiddhanta

4.4 Concept of Kaivalya

REFERENCE:

1. Saraswati, Swami Satyanand, (2012), "Four Chapters of Freedom", Bihar School of Yoga, ISBN 13-9788185787183.
2. Iyengar, B. K. S., "Light on the Yoga Sutras of Patanjali", Haper Collins Publications India Pvt. Ltd., New Delhi, ISBN 13-9788172235420.
3. Swami, Satchidananda, "The Yoga Sutras of Patanjali", Integral Publications, U.S.A., ISBN 13-9781938477072.
4. Taimini, Science of Yoga, ISBN 13-9788170592112.
5. Swami,Vivekananda, "Raja Yoga", ISBN 13-978100746940.
6. Mishra, Vachaspati, "Yoga Sutra (TatvaVaishardi)", ISBN 13-9780404578046.
7. Shastri, Vijaypal, "Yoga SurtaVimarsh", ISBN 13-9780865477360.
8. Lakshmananand, "Yoga Prakash", ISBN 13-9788175971240.
9. Suresh Chandra Shrivastava, Patanjali Yoga Darshan
10. Ram Prasad, Patanjali Yoga Sutra.
11. T.S. Rukmani, Vol.I-IV, Patanjali Yoga Sutras.
12. Baron, R.A. (2007). Psychology (Fifth edition) New Delhi: Pearson Prentice-Hall of India.
13. Clifford T. Morgan, Richard a. King, John R. Weis and John Schopler (1993), "Introduction to Psychology" – 7th Edition. Tata McGraw Hill Book Co. New Delhi.
14. Shanti PrakashAtrey, "Yoga Manovigyan".
15. R.S. Bhoghal, "Yoga & Mental Health".
16. R.S. Bhoghal, "Yoga evamMansikSwasthya".
17. Prof. Ramharsh Singh, "AyurvediyaManasVigyan".
18. Prof. Suresh LalBaranwal, "Yoga evamMansikSwasthya".

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SEMESTER–II
PAPER- II : ARHAM YOGA
Subject Code: (PGDY CC-202)

UNITI

ArhamDhyanYog

Antiquity ofJainYoga, Various dimensions ofJainYoga, KarmaSoul and Arhamyoga, IntroductionToTheAshtangasofYoga, YogabyAcharyaPujyapadLimbs of yogby ShriVeersenAcharyaMeaning of Arhammantra.

UNITII

MethodandBenefits

PanchParmeshthi Arham-FiveStepsProcess, Panch mudra in detail Spiritualyōga, ArhamMantraPower, Trayaśuddhi:triadpurification,PositiveAffirmations,

UNITIII

Pranayam

Prāṇa ,TypesofPrāṇa,Lifeexpectancyandrespiration, TypesofPrāṇāyāma, śvāsōcchvāsa, Types ofbreath

UNIT IV

ArhamAshtangYog

8limbsofMeditation, 8limbsofmeditation, GoalofMeditation-Dhyey, Place, time and Method of meditation,

UNIT V

Theoreticalandscientificanalysis

HowistheMind?, Do's and Don'ts, Diet, śākabhuk-VegetarianFood,Healthyfood,Quanttyoffood, Aftermealwalk

REFERENCES:

1. Rao, V. Manglagowri (2007), "The Text Book of Swasthavritta", ChaukhambhaOrientalia, Varanasi, 97881-7637-034-9.
2. CharakSamhita (1st part), Choukhambha Sanskrit Sansthan, Varanasi, ISBN 81-7080-014-5, 1994.
3. SushrutSamhita (Sutra sthan and Sharirsthan), ChoukhambhaOrientila, ISBN 978-0199360079.
5. AshtangaHradayam (Sutra sthan), Choukhambha Sanskrit Sansthan, Varanasi, ISBN 10:8121800226.
6. Swami, ShivanandaSaraswati, (1957) "Yoga Therapy, Umachal Yoga Ashram, Guwahati".
7. Verma, Janki Prasad, (1962), "Rogo Ki achukeChikitsa" Leader Press, Allahabad
8. Yogeshwar, "Simple Yoga Therapy", Yoga Center, Madras.
9. Tiwari, O. P., (1984), "Asanas–Why and How", Kaivalayadhama, Lonavala.
10. Kuvalayananda Swami, (1993), "Asanas", Popular Prakashan, Kaivalayadhama, Lonavala.
11. Sharma VishwamitraAacharya, "SachitraYogasanAurSwasthya", ManojPrakashan, Delhi.

PAPER-III: PRINCIPLES OFPSYCHOLOGY AND COUNSELING
Subject Code: (PGDY CC-203)

UNIT-I

1. INTRODUCTION TO PSYCHOLOGY

1.1 Definition, meaning and scope of Psychology
1.2 Branches of Psychology
1.3 Relevance and Contribution of Psychology in Teaching and Learning Process of Yoga Education
1.4 Different Methods of Psychology (Introspection, Observation, Experimental, Survey, Clinical)

UNIT-II

2. CONCEPT OF PERSONALITY

2.1 Indian and Western approach to personality.
2.2 Theories of personalities.
2.3 Personality Test (Big Five).
2.4 Attitude change though Yoga & Developing Yogic Personality.

UNIT-III

3. PSYCHOLOGY AND YOGA

3.1 Introduction to Psychological and Transcendental perspective of Yoga.
3.2 Meaning and Characteristics of Mental Health.
3.3 Mental Relaxation through Prayer, A cross cultural approach to Mental Health.
3.4 Yogic Life Style for Stress, Anxiety and Depression.

UNIT-IV

4. INTRODUCTION TO GUIDANCE COUNSELING

4.1 Need, Meaning and Importance of Guidance and Counseling in Yoga Education
4.2 Different Types of Counseling: (Individual and Group counseling).
4.3 Approaches of Counseling: Directive, Non directive, Techniques in Counseling: (Testing and Non Testing Techniques).
4.4 Yoga Meditation: Metaphysical and Therapeutic Perspective

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13. R.S. Bhoghal, "Yoga evamMansikSwasthya".
14. Prof. Ramharsh Singh, "AyurvediyaManasVigyan".
15. Prof. Suresh LalBaranwal, "Yoga evamMansikSwasthya".

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SEMESTER–II
PAPER-IV: ALTERNATE THERAPY
Subject Code: (PGDY CC-204)

UNIT-I

1. INTRODUCTION TO ALTERNATE THERAPIES

1.1 Introduction to alternate therapies and Types of Alternate therapies
1.2 Historical background and development of alternate therapies all around the world
1.3 Comparative study of Alternate therapies with other systems of medicine
1.4 Need of Alternate Therapies in the present times

UNIT-II

2. MANIPULATIVE THERAPIES & PHYSICAL BODY

2.1 AccupressureandAccupuncture – Introduction and basic principles
2.2 Reflexology andSujok – Concept and fundamentals of their functioning
2.3 Magnetotherapy- Principles of Magnetotherapyand its application
2.4 Massage Therapy & its benefits

UNIT-III

3. INTRODUCTION TO AYURVEDA, COLOUR & AROMATHERAPY

3.1 Ayurveda – Concept of Ayurveda and its role in healthy living
3.2 Panchkarma- Process and Benefits
3.3 Colourtherapy and spectrum of colours
3.4 Aromatherapy – Basic principles of Aromatherapy and its role in relaxation

UNIT-IV

4. PSYCHO-SPIRITUAL THERAPIES

4.1 Pranic Healing Methods and its application
4.2 Reiki – Introduction, concept and laws of Reiki healing
4.3 Hypnotherapy – Concept of Hypnotherapy
4.4 Introduction to Astrology and Religious Beliefs

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SEMESTER-II
Yoga Practical Syllabus (PART-B)
Subject Code: (PGDY PC-201)

B-1: SYLLABUS FOR YOGA PRACTICAL - II

1. ASANAS:
   i) **Surya Namaskara**
   ii) **SukshamaVyayama by DheerendraBrahmachari**
   iii) **Meditative Asanas:**Guptasana, Vajrasana, Bhadrasana
   iv) **Relaxation Asanas:** Balasana, Shashankasana
   v) **Supine Asanas:**Halasana, Chakrasana, Markatasana, Setubandhasana , Suptabaddhakonasana
   vi) **Prone Lying Asanas:** Sarpasana , VipreetaNaukasana, Dhanurasana, Shalabhasana
   vii) **Sitting Asanas:**Vyaghrasana, Mandukasana, Bakdhyanasana, Gomukhasana, Marichyasana I, Rajkapotasana, Bharadwajasana
   viii) **Standing Asanas:** Trikonasana, Ardha Kati Chakrasana, Veerbhadrasana (I &II)
   ix) **Inversion Asanas:** Sarvangasana, Sirshasana, Salambasirshasana
   x) **Advanced Group Asanas:** PadaAngusthasana, Garbhasana, Baddhpadmasana, Kukkutasana, Bakasana, Hanumanasana, Kurmasana, UttanaKurmasana, Tittibhasana, Mayurasana, Padma Mayurasana

2. **PRANAYAM:**Ashtakumbhaka of Hatha Yoga Pradipika

3. **BANDHAS & MUDRAS:** MoolaBandha, MahaBandha, VipareetKarani Mudra, Khechari Mudra, Tadagi Mudra, Pashinee Mudra, , Maha Mudra, MahaBheda Mudra

4. **SHATKARMA:** Kapalbhati Three Types (Vyutkarma, SheetkarmaandVaatkarma), Nauli, Trataka, DandaDhauti, VastraDhauti

5. **MEDITATION TECHNIQUES:** SohamDhyan, SavitaDhyan
6. **RELEXATION TECHNIQUE:** Yoga Nidra (advance)

SEMESTER-II
Alternate Therapies Practical / Viva Voce Syllabus (PART-B)
Subject Code: (PGDY PC-202)

B-2 ALTERNATE THERAPY PRACTICAL

Alternate Therapies

1. Practice of Massage Therapy and its application.
2. Concept of Sujok and Demonstration of basic Accupressure Points and Reflexology
3. Magnetotherapy- Basic Instruments & method of working
4. Case Study Record should be maintained separately at least 5 person, practical record books should be maintained.
5. Viva Voce based on the Theory Paper of Alternate Therapies.

INTERNAL ASSESSMENT CRITERIA
(P.G. Diploma in Yoga Education)

Internal Assessment for all subjects in P.G. Diploma in Yoga Education will be done as follows:

(1)	Assessment within Class	:	(10)
(2)	Class Test	:	(05)
(3)	Assignement	:	(05)
(4)	Attendance*	:	(05)
(6)	Total	:	(25)

NOTE: *Criteria for giving marks of attendance

% of Attendance	Marks
50%	1
60%	2
70%	3
75%	4
80%	5
85%	6
90%	7
94%	8
97%	9
100%	10

Dr. B. R. Ambedkar University, Agra

(Formerly : Agra University, AGRA)

CURRICULUM FOR

MASTERS OF PHYSICAL EDUCATION AND SPORTS (M.P.E.S.) PROGRAMME

TWO YEAR - (FOUR SEMESTERS)

ORDINANCE, REGULATIONS AND SYLLABUS FOR M.P.E.S. (CBCS)

Preamble :

Master of Physical Education and Sport (M.P.E.S.) two years (Four Semesters Choice Based Credit System) program is a professional program meant for preparing teachers of physical education at highereducation and professional jobs at university and sports industries.

M.P.E.S. program is designed to integrate the study of subject knowledge, pedagogical knowledge, andthe aim of Physical Education and communication of games and sports skills. The program comprises of compulsory and optional theory as well as practical courses and compulsory internship.

A) M.P.E.S.

a. 1. Eligibility

I For Admission

A) Candidate seeking admission to M.P.E.S. program must satisfy the following conditions.

B) He/She must be B.P.Ed., B.P.E.S or B.Sc. (Health & Physical Education) from University

C) He/She must have taken at least 55% marks in B.P.Ed,/B.P.E.S/B.Sc (Health & Physical Education) B.A. Physical Education as a Elite Subject Candidate belonging to scheduled cast scheduled tribe would be given concession of 5% marks in the minimum marks required for admission or eligibility criteria of Dr.B.R.Ambedkar University, Agra Admission ordinance.

D) Admission shall be made on merit on the basis of marks obtained in the entrance test (written test, sports proficiency test, physical fitness test & marks obtained in the qualifying examination) or any other selection process as per the policy of University of Dr.B.R.Ambedkar University, Agra Admission ordinance.

E) The provision of seats and the relaxation in qualifying marks for SC/ST/OBC and other categories shall be as per the rules of the central government/state government. Whichever is applicable.

F) Graduation with 45% marks and at least three years of teaching experience (for deputed in service candidates i.e trained physical education teachers/coaches)

II For the M.P.E.S. Degree : The candidates shall have subsequently undergone the prescribed course of study in the university department or a college affiliated to his University for a period of not less than two academic years, passed the examinations prescribed and fulfilled such conditions as have been prescribed there for M.P.E.S.

b .2. Duration :

The M.P.E.S. program shall be of duration of two academic years, that is, four semesters. However, the students shall be permitted to complete the program requirements within a maximum of three years from the date of admission.

3. The CBCS System:

All Programs shall run on Choice Based Credit System (CBCS). It is an instructional package developed to suit the need of students, to keep pace with the developments in higher education and the quality assurance expected of it in the light of liberalization and globalization in higher education.

4. Course :

The term course usually refereed to, as 'papers' is a component of a program. All courses need not carry the same weight. The courses should define learning objectives and learning outcomes. A course may be designed to comprise Lecturer/tutorials/ laboratory work/fieldwork/Outreach activity (Educational Tours activities)/ project work/vocational training/viva/seminars/term papers/assignments/ presentations/self-study etc. or a combination of some of these.

5. Courses of Program:

The M.P.E.S. Program consists of a number of courses, the term 'Course' applied to indicate a logical partof subject matter of the Program and is invariably equivalent to the subject matter of a "paper" in the conventional sense. The following are the various categories of courses suggested for the M.P.E.S. Program.

6. Semesters:

An academic year is divided in to two semesters, each semester will consist of 17-20 weeks of academic work equivalent to 100 actual teaching days excluding examination days. The odd semester may be scheduled from June/July to December/January and even semester from December/January to June/July. The institution shall work for a minimum of 36 working hours in a week (five or six days a week).

7. Working Day:

There shall be at least 200 working days per year exclusive of admission and examination processes etc.

8. Credits:

The term 'Credit' refers to a unity by which the program is measured. It determines the number of hours of instructions required per week. One credit is equivalent to one hour of teaching (lecture or tutorial) or one and half/ two hours of practical work/field work per week. The term 'Credit' refers to the weight given to a course. Usually in relation to the instructional hours assigned to it. The total minimum credits, required for completing a M.P.E.S. Program is 90 credits and for each semester 20 credits.

9. Examinations:

i. There shall be examinations at the end of each semester, for first semester in the month of December/January: for second semester in the month of May/June. A Candidate who does not pass the examination in any Subjects shall be permitted to appear in such failed subjects in the subsequent examinations to be held in November/December or May/June.

ii. A candidate should get enrolled/registered for the first semester examination. If enrollment/registration is not possible owing to shortage of attendance beyond condition limit/rules prescribed OR belated joining OR on medical grounds, such candidates are not permitted to proceed to the next semester. Such candidates shall redo the semester in the subsequent term of the semester as a regular student; however, a student of first semester shall be admitted in the second semester, if he/she have successfully kept the term in first semester.

10. Conditions:

Student must have 75% of attendance in each course for appearing the examination. Students who have 74% to 65% of attendance shall apply for condition in the prescribed form with the prescribed fee. Students who have 64% to 50% of attendance shall apply for condition in prescribed form with the

prescribed fee along with the Medical Certificate. Student who participate in sports competition affiliated by IOA shall apply be considered in examination with the permission of head of the department. Students who have below 50% of attendance are not eligible to appear for the examination.

11. Pattern of Question Papers:

Question Papers shall have five questions corresponding to four unit s of each theory course.

M.P.E.S. : Format of Questions Paper For 4 Units

Each question paper shall have five questions. The pattern will be as follows:

Question No.	Description	Marks
1	**Answer in detail (Long Question)** **Or** **Answer in detail (Long Question) (Form Unit 1)**	15
2	**Answer in detail (Long Question)** **Or** **Answer in detail (Long Question) (Form Unit 2)**	15
3	**Answer in detail (Long Question)** **Or** **Answer in detail (Long Question) (Form Unit 3)**	15
4	**Write short notes: any two out of four** **(Form Unit4)**	15
5	**M.C.Q. Type Questions (10 out of 12 Question)** **(3 Questions. from each unit)**	10
Total		70

12. Evaluation :

The performance of a student in each course is evaluated in terms of percentage of marks with a provision for conversion to grade point. Evaluation for each course shall be done by a continuous.

Internal assessment (CIA) by the concerned course teacher as well as by end semester examination and will be consolidate at the end of course. The components for continuous internal assessment are;

One Test	**15 Marks**
Seminar/Quiz	**5Marks**
Assignments	**5Marks**
Attendance	**5Marks**
Total	**30 Marks**

Attendance shall be taken as a component of continuous assessment, although the students should have minimum 75% attendance in each course. In addition to continuous evaluation component, the end semester examination, which will be written type examination of at least 3 hours duration, would also for man integral component of the evaluation. The ratio of marks to be allotted to continuous internal assessment and to end semester examination is 30:70. The evaluation of practical work, wherever applicable, will also be based on continuous internal assessment and on an end-semester practical examination.

13. Minimum Passing Standard:

The minimum passing standard for CIA (Continuous Internal Assessment) and External Examinations shall be 40%, i.e. 12 marks out of 30 marks and 28 marks out of 70 marks respectively for theory course. The minimum passing for both CIA & external examination shall be 50%, i.e. 15 marks out of 30 and 35 marks out of 70 Marks for the practical courses.

14. Award of the M,.P.E.S. Degree:

A candidate shall be eligible for the award of the degree of the M.P.E.S. Only if he/she has earned the minimum required credit.

15. Assessment and Evaluations:

TOTAL MARKING SYSTEM

[SEMESTER	THRORETICAL	PRACTICAL	CREDITS
Semester – 1	**400**	**200**	**24**
Semester – 2	**400**	**200**	**24**
Semester – 3	**400**	**200**	**24**
Semester – 4	**400**	**200**	**24**
Total	**1600**	**800**	**96**

I. Each course will be assessed on the basis of 100 marks. The marks would be divided between internal and external assessment.

II. There shall be one end semester external examination for each course in every semester consisting of 70% (70 marks) weight in theory and 75% (75 marks) in practical courses.

III. Each Theory course shall have internal assessment of 30% weight age on the

followingInternal written test - 15% (15 marks) Attendance - 05% (5 marks)

Class participation in assignments- 05% (5 marks) Presentations (Seminars) /quizzes etc. - 05% (5 marks)

Total 30 marks

IV. Each Practical Course shall have internal assessment of 50% weight age on the

followingOne Test 15 marks Project 10 marks

Attendance 05 marks

Total 30 marks

- The University examination in Thesis for Semester IV shall consist of the examination of the thesis. One internal examiner shall evaluate the thesis out of maximum of 30 marks and one external examiner who shall evaluate the thesis out of maximum of 70 marks. There shall be a viva-voce at internal and external examination of 70 marks.

V. Every student will be required to pass the external examination and internal assessment separately in each course.

VI. The minimum passing standard will be 40% for the external and internal component of each theory course, i.e. 28 marks out of 70 and 12 marks out of 30 .In practical minimum passing standard will be 50%for the external exam and internal assessment for each practical course.

VII. Attendance shall be taken as a component for continuous assessment, although the students should put in minimum of 75% attendance in each course. In addition to continuous evaluation component, the end semester examination, which will be written type examinations of at least 3 hours duration, would also form an integral component of the evaluation. The ratio of marks to be allotted to continuous internal assessment and to end semester, examination is 30: 70 in theory &25: 50 in practical.

VIII. (A) The grades for each course would be decided on the basis of the percentage of marks obtained in the end-semester external and internal examinations as per the following table:

Percentage	Grade Point	Grade	Description	Classification of final result
85 & above	8.5-10.0	O+	Outstanding	First class with Distinction
70-84.99	7.0-8.49	O	Excellent	
60-69.99	6.0-6.99	A	Very Good	First Class
55-59.99	5.5-5.99	B+	Good	Higher Second Class
48-54.99	4.8-5.49	B	Fair	Second Class
36-47.99	3.6-4.79	C	Average	Pass Class
Below 36	0.0	D	Fail/Dropped	Dropped

IX. The semester grade point average (SGPA) will be calculated as a weighted average of all the grade point of the semester courses. That is Semester grade point average (SGPA) = (sum of grade points of all six courses of the semester) / total credit of the semester as per example given below:

Course No	Credit	Marks out of 100 (%)	Grade	Grade Point	Credit Grade point
Course -1	4	65	A	6.5	26
Course -2	4	60	A	6.0	24
Course -3	4	62	A	6.2	24.8
Course -4	4	57	B+	5.7	22.8
Course -5	4	55	B+	5.5	22
Course -6	4	72	O	7.2	28.2
Total	24				147.8

Examples: Conversion of marks into grade points

65=60+5=6.0+5x(0.99/9.99)=6.0+5x0.1=6.0+0.5=6.5

57=55+2=5.5+2x(0.49/4.99)=5.5+2x0.1=5.5+0.2=5.7

72 = 70 + 2 = 7.0+ 2 x (1.49 /14.99) = 7.0 + 2 x 0.1 = 7.0 +0.2 = 7.2

X. SEMESTER GRADE POINT AVERAGE (SGPA) = Total Credit Grade Points = 147.8 /24 =6.16 SGPA Sem. I=

6.16 SGPA Sem. II = 5.63
SGPA Sem. III = 6.01
SGPA Sem. IV = 5.50

Total SGPA = 23.30

Cumulative Grade Point Average (CGPA) =23.30
4 = 5.82 CGPA = 5.82 Grade = B+ Class = Higher Second Class

GPA X 10 = Percentage e.g. 5.82 X 10 = 58.2 %

Note:

(1) SGPA is calculated only if the candidate passes in all the courses i.e. get minimum C grade in all the courses.

(2) CGPA is calculated only when the candidate passes in all the courses of all the semesters.

XI. The cumulative grade point average will be calculated as the average of the SGPA of all the four semesters, as shown above.

XII. Forth award of the class, CGPA shall be calculated on the basis of:

(a) Marks of End Semester External Examination And

(b) Total Marks obtained (Marks of End Semester External Examination

+ Marks of Internal Assessment) for each course. The final Class for M.P.E.S. Degree shall be awarded on the basis of lowest CGPA (marks) of (a) & (b) of one to fourth semester examinations.

16. Conferment of the M.P.E.S. Degree:

(i) A candidate shall be eligible for the conferment of the Degree of M.P.E.S. only if he/she has earned the minimum required credits for the program prescribed therefore (i.e. 96 Credits).

17. End Semester Examination:

(i) The University shall conduct the external Examination for the Semester-I, II, III & IV. The internal examination shall be conducted by the concerned Departments.

M.P.E.S. Semester-1

Part A: Theoretical papers

Examination Evaluation

Course code	Title of papers	Credit	Internal marks	External marks	Total marks
cc-101	Research methods in physical education	4	30	70	100
cc-102	Health education	4	30	70	100
cc-103	Information technology in physical education and sports	4	30	70	100
cc-104	Elective course(any one) sports journalism/ sports sociology	4	30	70	100

Part –B Practical course

Course code	Title of papers	Credit	Internal marks	External marks	Total marks
Pc-101	Athletics (running events)	4	30	70	100
Pc -102	Kho kho, football, hockey basketball, badminton kabaddi (anyone out of these) sports theory, skills techniques and officiating	4	30	70	100
	Total	24	180	420	600

M.P.E.S. Semester-IInd

Part A: Theoretical papers

Examination Evaluation

Course code	Title of papers	Credit	Internal marks	External marks	Total marks
cc-201	Statistics in physical education and sports	4	30	70	100
cc-202	Sports psychology	4	30	70	100
cc-203	Exercise physiology	4	30	70	100
cc-204	Elective course(any one) principal and organization of recreation/ professional preparation and curriculum design	4	30	70	100

Part –B Practical course

Pc-201	Athletics (jumping events)	4	30	70	100
Pc -202	Table tennis handball, cricket, boxing, judo (anyone out of these) sports theory, skills, techniques and officiating	4	30	70	100
	Total	24	180	420	600

M.P.E.S. Semester-IIIrd

Part A: Theoretical papers

Examination Evaluation

Course code	Title of papers	Credit	Internal marks	External marks	Total marks
cc-301	Bio -mechanics	4	30	70	100
cc-302	Sports management	4	30	70	100
cc-303	Test measurement and evaluation in physical education and sports	4	30	70	100
cc-304	Elective course(any one) physical fitness and wellness/ gender disability and inclusive sports education	4	30	70	100

Part –B Practical course

Pc-301	Athletics (throwing events)	4	30	70	100
Pc -302	Volleyball, wrestling, lawn tennis ,tae Kwando (anyone out of these sports theory, skills techniques and officiating	4	30	70	100
	Total	24	180	420	600

M.P.E.S. Semester-IV

Part A: Theoretical papers

Examination Evaluation

Course code	Title of papers	Credit	Internal marks	External marks	Total marks
cc-401	Scientific principal of sports training and coaching	4	30	70	100
cc-402	Sports medicine	4	30	70	100
cc-403	Yogic science and naturopathy	4	30	70	100
cc-404	Elective course(any one) philosophical foundation and history of physica education and sports dissertation	4	30	70	100

Part –B Practical course

Pc-401	Lesson plan of specialization	4	30	70	100
Pc-402	Classroom teaching	4	30	70	100
	Total	24	180	420	600

Semester - I

Paper – 1

Research Methods in Physical Education& Sports

Unit 1.

- Meaning, Definition, Nature, Importance and Scope of Research in Physical Education & Sports.

Unit 2.

- Meaning, Definition and Selection of Research Problem.
- Hypothesis and Review of Related literature, Library Techniques.

Unit 3.

- Sampling-Meaning, Definition, Types and importance.
- Sampling- Process and Techniques
- Research Tools-Questionnaire, Interview, Opinion ireetc.

Unit 4.

- Research Methods and Procedure.
- Historical Research-Meaning, Definition and Importance, Primary and Secondary Sources, External and Internal Criticism.
- Descriptive Research-Survey Studies(Meaning, Definition and Importance)
- Case Studies.
- Experimental Research- Meaning, Definition, Need and Experimental Designs and Laboratory Designs.

Unit 5.

- Research Proposal
- Research Report
- Preparation of a Research Report.

References:

1. Author's Guide: "Research Methods Applied to Health Physical Education and Recreation", Washington, D.C.,1991.
2. Best J.W., "Research in Education", Prentice Hall, New Delhi 1982.
3. Clarke H. David, "Research Processes in Physical Education, Recreation and Health", Prentice HallInc, Englewood Cliffs, New Jersey, 1985.
4. Kamlesh M.L., "Methodology of Research in Physical Education and Recreation", AHPER, Washington D.C., 1973.

Semester - I

Paper – 2

Health Education

Unit 1.

- Health-Guiding Principles of Health and Health Education.
- Health related fitness.
- Obesity and its Management.

Unit 2.

- Environmental and Professional Hazards and First Aid.
- Public Health and Epidemic Diseases-Symptoms, Treatment and Preventive Measures.
- Communicable Diseases-Symptoms, Treatment and Preventive Measures.

Unit 3.

- School Health Program and Personal Hygiene.

Unit 4.

- Theories and Principles of Recreation
- Recreation programs for various categories of people.

Unit 5.

- Population Education
- Causes for population explosion and its preventive steps.
- National family welfare scheme.
- Nutrition and Dietary manipulation.

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1. Greene, W.H., Simon-Morton, B.G.(1984). Introduction to Health Education. NY: Macmillan Publishing Company
2. Anspaugh, D.J., Ezell, G. (1995). Teaching today's health (4th Ed). Boston: Allyn & Bacon Park, K. (2007). Park's textbook of Preventive & social medicine (19th Ed). India: Varanasi das Bhanot Publishers.
3. Y.P. Bedi: Hand Book of Hygiene and Public Health.
4. Ma Curdy and Ma Grace : Muscular Exercise.
5. Peter V.Karpovich: Physiology of Muscular Activity.
6. Anatomy, Physiology, Kinesiology & Health Education : Dr. Ramesh Chand Kanwar

Semester - I

PAPER -3 Information Technology in Physical Education.

Unit 1.

Local Area Network and Internet

A. Networking

- Area and Classification
- Features and characteristics of LAN, Need of Network and its importance.
- LAN Topology-Ring, Star, Bus, Pitcher, Two Pitcher
- LAN, Survey, Work Station, Connection, Cable.

B. Internet

- Meaning, History, Application and Address.
- Introduction of Modem, Web client, Web Server.
- Dial up, Access, Direct Access.
- Introduction of Web browser, Use of Web browser (For Sports and Games)
- Introduction of Search engine, Uses, Objectives and types.
- Meaning and Definition of Firewall and Gateway.

C. Email

- Introduction, How to receive and send, how it works and Address book etc.

Unit 2.

Web Designing

- Introduction.
- Web browser and Programming.
- Program structure, Pair, Tag, Document, Head and Body Tag.
- Leaking Documents, Internal and External Documents.
- Heading Line, Drawing Line.
- Paragraph break- Font Styles (Bold, Italic and Underline)
- Types of Lists-Order and Unordered.

- Graphics, Images, Sound and Video.
- Tools, Header, Dia, Row, use of Caption Tag Width, Border, Working, Spacing, Bg Colour Column and Row. Spy Alignment (Column etc.)
- Form-Introduction, Design, Creation.
- Check box, Control Text box, Drop down, List box, Command and action button.

Unit 3.

- Multimedia and Presentation package.
- Fundamentals and application of multimedia.
- Tools of multimedia(Sports)
- Introduction of graphics, animation and morphing.
- Sound and Music

Unit :4

Presentation package

- Introduction, General Objectives, Tips on effective presentation, Opening, Creative presentation, Creative table, Making chart, Save and close, New slide, Slide change, Creation of black presentation, Changing font size, Working with graphic action button.

Unit 5.

Organizing various sports activities using Microsoft projects.

- Lab work : Introduction to sports software, Introduction to internet, Study of Email, Browsing sports activities on Internet, Preparing Slideshow on power-point, Preparing Slideshow on Multimedia, Teaching Multimedia package, Web Design.

References:

1. Irtegov, D. Operating System Fundamentals. Firewall Media.2004.
2. Milke, M Absolute Beginner's Guide to Computer Basics, Pearson Education Asia2007.
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4. Computers Today. Suresh K. Basandra, Galgotia publication, upgradededition-2008
5. Computers in Your Future, Marilyn Meyer & Roberta Baber,2nd edition, Prentice HallIndia
6. Computer Fundamentals. Pradeep K. Sinha & Priti Sinha, 4th edition, BPB Publication

SEMESTER I

Paper – 4.2

(Elective) Sports Journalism

Unit 1. Development of Journalism in India:

- Publication of newspapers in India
- Press, Literature, Renaissance.
- Group Mediums, Newspapers, Magazines, Television, Radio, Internet-Symptoms, Advantages and disadvantages.
- Importance of Sports Journalism.
- Language skill writing and Editing.
- Selection of Headers and Footers, Pictures, Layout, Design, Cartoon, Graphics, Graphs.

Unit 2. Qualities of Sports Journalist and Consolidation of news:

A. Qualities

- Knowledge of the game, Specialist in Sports.
- Research Attitude
- Individual Preparation and Cooperation.
- Specialization in Public Relations.
- Knowledge of the laws of the games.
- Urge for new knowledge.

B. Consolidation of News through,

- Individual sources,
- Commercial agencies,
- Newspaper listings,
- Meetings and seminars,
- Radio and television,
- Internet.

Unit 3. Difference between compilation of newspapers and magazines:

- Difference between newspapers and magazines
- Difference between writing styles
- Difference between presentations.
- Difference between selections of newspapers.
- Special skills.
- Selection of Pictures. Intro writing
- Intro writing of contemporary event or incident.
- Offhand comment on special occasions.

Unit 4. Sports administration and management:

- Level of Authorities: Different sports Associations, Universities, Colleges, schools etc.
- Level of Invitee/Non official: Association, Mandals, Clubs, Corporation, Social institutions, Society etc.

Unit 5. Welfare schemes:

- Awards to sportsmen: Arjun, Padmashree, Khelratna, Eklavya etc.
- Priority in Government jobs.
- Prizes and consolations for excellent performance.
- Benefit matches.
- Priority for additional marks for college admissions.

References:

1. Ahuja, B.N., Theory and Practice of Journalism, Surjeet Pub, Delhi, 1988.
2. Health Jr. Gelfand, How to Cover, Write and Edit Sports, Annes Lowa, USA, 1951.
3. Juris, John R., The Writing Games, Columbia Univ. Press, New York, 1969.
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5. "Sports" by Bhola Singh Thakur (pp.111.1240) in the Indian Reporter Guide by Richard Richfield. Allied Pacific Pvt. Ltd., Bombay, 1962.
6. Woodward. S., Sports Page, Simon and Schuster, New York.1949.

Semester - I

Paper – 4.2

Sports Sociology (Elective)

Unit 1 Earning, Scope, Methods and Use.

A. Sociological Classification of Sports.

- Sociological concept and classification.
- Sports Research
- Concept and understanding of Sports.

Unit 2 Sports group and Administration:

A. Group Leadership, Constitution Methodology.

B. Administrative Leadership, Constitution ,Methodology.

Unit 3. Games and Social Institutions:

- Contribution of Family
- Educational Methods in Sports
- Contribution of socialization in sports.
- Socialization through sports

Unit 4. Sports and Social Status

- Sports Socialization and Limitations
- Sports related problems and Trends in Society.
- Sports and Aggression.
- Violence in sports.
- Commercialization in sports
- Women and Children in sports.

Unit 5. Sports and Micro Social System

- Study of Sports Groups
- Group Interaction, Competition and Co-operation
- Sports and Culture

REFERENCE:

1. Loy, John W., Kenyon, gerald S. & McPherson, Barry D. Sports Culture and Society (Philadelphia: Lea & Febiger, 1981).
2. Ball, Donald W. and Loy John W. Sport and social Order; Contribution to the sociology of sport, (London: Addison Wesley Publishing Co., Inc., 1975).
3. Loy John. W. McPherson, Barry D., and Kenyon Gerald, sport and Social System (London: Addison Wesley Publishing Company Inc.,1978).
4. Edward Larry. Sociology of sport (Illinois: The Dorsey Press,1973).
5. Cratty, Brayant J. Social Dimensions of Physical Activity New Jersey: Englewood Cliffs, Prentice Hall Inc., 1967.

Semester - II

Paper – 1

Statistics in Physical Education& Sports

Unit 1. Statistics: Meaning, Definition, Nature and Importance.

- Class Intervals: Raw Score, Continuous and Discrete Series, Class Distribution, Construction of Tables and Calculation.
- Graphical Presentation of Class Distribution, Histogram, Frequency Polygon, Frequency Curve. Cumulative Frequency Polygon, Ogive, Pie Diagram.
- Measures of Central Tendency: Mean Median and Mode- Meaning, Definition, Importance, Advantages and Disadvantages.
- Calculation of Mean and Median, Grouped and Ungrouped data, Raw Mode and calculation of mode from class intervals.

Unit 2. Measures of Variability

- Deviation, Percentiles and Quartiles-Meaning and Use.
- Calculation of Deviation Percentiles and Quartiles.
- Range, Quartile Deviation, Mean/Average Deviation, Standard Deviation-Meaning, Definition and use.
- Calculation of Quartile, Mean and Standard Deviation from Grouped and Ungrouped data.

Unit 3. Correlation:

- Meaning and Types.
- Calculation of Karl Pearson (Product Moment Method) and Spearman-Rank Order Correlation Method.

Unit 4. The Normal Curve:

- Meaning, Principles, Laws, Properties and Uses.
- Divergence from Normality-Skewness and Kurtosis.
- Scoring Scales- Sigma scale, Z Scale, T Scale.

Unit 5 : Reliability

- Meaning, Factors affecting Reliability.
- Randomization.

- Significance of difference between Means.
- T-test and F-test- Uses, Meaning.
- Calculation of T-test.
- Type I and Type II Errors.
- One Tailed and Two Tailed Tests.
- Null Hypothesis.

REFERENCE:

1. Best, john W. Research in Education, New Delhi Prentice Hall of India (P) Ltd. 1963.
2. Clarke David H. and Clarke H. Harrison, research Process in Physical Education, Recreation and Health, Englewood Cliffs, New Jersey Prentice Hall Inc.1979.
3. Clarke H. Harrison, the Application of Measurement in Healand Physical Education New York, Prentice Hall Inc.1979.
4. Good V. Caster and Scates Douglas E., Methods of research Application – Century, New York, 1954.
5. Mauly George J., The Science of Educational Research, New Delhi Eurasia Publishing Hours (P), 1963.
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8. Garret, Harry E and Good Worth R.S., Statistics Psychology and Education, Bombay Allied pacific Private Ltd.19.
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10. Guilford J.P., fundamental of Statistics in Psychology Educational, New York: McGraw Hill Book Cp. Inc.1956.

Semester - II

Paper – 6

Sports Psychology

Unit 1. Sports Psychology:

Meaning, Definition, Nature, Scope and Importance.

Unit 2. Process of Learning: Meaning, Definition, Principles, Laws and their implementation.

- Individual Differences: Meaning, Definition, Types and Reasons.
- Body Types: Sports Activity according to body types, Effect of Individual differences on skill acquisition and sports performance.

Unit 3.

- Emotion: Meaning, Definition, Types and Characteristics. Factors effecting Sports Achievement such as Stress, Fear, Frustration and Aggression.
- Motivation: Meaning, Definition, Types and Importance of Motivation in Sports Achievement.

Unit 4.

- Personality: Meaning, Definition and Principles.
- Dimensions of Personality, Views of Personality.
- Personality development through Physical Activities and Games.

Unit 5.

- Psychological Dimension of Competition-Psycho-Regulative Method for Excitement and Mental Relaxation.
- Effect of Audience on the performance of the Athletes.
- Psychological Preparation for competition-Short term and Long Term Preparation.

REFERENCE:

1. Alderman, R.B. *Psychological Behaviour in sports.* (Philadelphia: London, Sounders Company,1974).
2. But Susan Dorcas, *Psychology of Sports* (Network: Van Nastrand Reinhold Company) Edn.2.
3. Crattybrayant, J. *Movement Behaviour and Motor Learning***.** (Philadelphia: Lea and Febiger, 1973),Edn. 3.
4. Craty Bryant, J. *Psychology and Physical Activity.*(New Jersey Englewood Cleffs, Prentice Hall Inc.1965).
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10. Martens Rainer, *Social Psychology and physical Activity* (New York: Harper and Row Publishers, 1975).
11. Robert Glyn C. *Learning Experiences in sports Psychology***.** (Illinois: Human Kinetics Publisher Inc.1986).
12. Martens Rainer, *Coaching Guide to Sports Psychology* (Illinois: Human Kinetics Publisher Inc.1987).
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Semester - II

Paper – 7

Exercise Physiology

Unit 1.

Exercise Physiology: Meaning, Definition, Importance and Scope.

Unit 2. Muscles, Types of Muscles and Types of muscular cells:

- Characteristics of Voluntary and Non voluntary Muscles.
- Design, Functions and Energy for Muscular Function
- Chemical Changes during muscular contraction.

Unit 3.

- Structure and functions of different systems of the body and effect of exercise on various systems. (Muscular System, Cardio-vascular System, Respiratory system, Nervous System and Digestive System)

Unit 4.

- Second Wind and Oxygen Debt.
- Warm up, Conditioning, Fatigue and (Prasham).
- Work Capacity under different environmental conditions.(Hot, Humid, Cold, High and Low Altitude)

Unit 5

- Sports and Nutrition.
- Concept of Balanced Diet.
- Pre Competition, During Competition and after competition diet of sportsman.
- Effect of smoking, Alcohol, Banned drugs on Sports Performance.

REFERENCE:

1. Guyton, Arthur C. Text Book of medical physiology. (Philadelphia: W.B. Saunder company, 1976).
2. Morehouse, L.E. and Miller, A.T. physiology of Exercise. (Saint Louis: The C. V. Mosby Company, 1976).
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Semester - II

Paper – 8.1

Principles and Organization of Recreation (Elective)

Unit 1. Concept of Recreation:

- Definition, Theory, Methodology and games.
- Concept of Recreation and Philosophy. Effect of Schools on different philosophies.
- Work, Relaxation and Recreation.
- Importance of recreation for Individual, Groups, Society, National and International brotherhood, Nature of Recreation activities.

Unit 2. History of Recreation:

- History of different activities and living styles of various civilizations, Momentum to different recreational activities, History of Vedic age, Epic age, Buddha age, Maurya age, British period, India after independence.
- Activities of villages and sources of recreation.

Unit 3.

- Planned momentum for recreational activities in India. Professor, C.D. Sondhi, Effect of Recreation on educational and industrial institutions, Y.M.C.A, Balkaan ji baati, Service and Ospel Club, Balabhavans, India Nation Association, National and International Associations.
- Comparative study of recreation-Agitation of Recreation in U.K, U.S.A, U.S.S.R, Japan, France and Germany and its effect on India.
- Recreational Schemes of State and National Government

Unit 4. Factors effecting Recreation

- Factors effecting population explosion, age, tribes and social status.
- Types of communities, urban, semi urban, rural, slums and business.
- Tools giving momentum to recreation and recreational institutions. Facilities for training.
- Effect of religions, tribes, knowledge and rituals.

Unit 5. Planning and Management.

- Survey of sources and needs.
- Preparing aims and objectives, managing programmes, managing funds.
- Place of training in recreational skills.
- Purchase, preservation and distribution of recreational tools.
- Establishment of evaluation methods.

References:

1. Dheer. S. & Radhika Kamal, Organization and Administration of Physical Education, Friends Publication, New Delhi – 1991.
2. Two Experienced Professors, Organization, Administration and Recreation in Physical Education, Parkash brothers, Educational Publishers, Ludhiana1986.
3. Butler G.O. introduction to "Community Recreation" Newyork Mc Graw-hill Co. Inc.1959 Dollar8.50.
4. H.D. Meyer and C.K. Bright bill community Recreation', A guide to its organization. NewZercy,1964.
5. "A Recreation". Professor Shri C.H. Dubey L.N.C.P.E. Gwalior.(M.P.)

Semester – II

Paper – 8.2

Professional Preparation and Curriculum Design (Elective)

Unit 1. Foundation of Professional Preparation:

- Ideals of Indian Democracy: Contribution of Physical Education.
- Forces and factors effecting educational policies- Social, Religious, Economical and political.
- Educational and professional preparation in physical education – Role of Central government.
- Professional Association. Professional Preparation in Physical Education:
- Historical review of professional preparation of Physical Education in India.
- Curriculum-Old and new concepts, Mechanics of curriculum planning.
- Basic principles of curriculum construction.

Unit 2. Under-graduate preparation of professional preparation

- Areas of Health education, Physical education and Recreation.
- Curriculum design-Experience of Education, Field and Laboratory.
- Teaching practice.
- Professional Competencies to be developed-Facilities and special resources for library, laboratory and other facilities.

Unit 3. Post-graduate preparation of professional preparation:

- Purpose of Post graduate studies.
- Area of specialization and concentration on core areas.
- Research requirements and methods of instructions.

Unit 4. Curriculum Design:

- Importance of curriculum design and effecting factors, Curriculum according to the needs of the students, national and professional policies.
- Role of teachers in curriculum design.
- Co-education and special programmes for women.

Unit 5.

- Selection of Teaching Method – Mass Education, Lecture, Project method and teaching aids.
- Time table for Physical Education and Sports activities in schools and classes.
- Supervision in Physical Education and Supervision methods.
- Recommendations for physical education curriculum by NCERT, CBSE, UGC, NCTE.

REFERENCE:

1. Brraw Harold M. Man and Movement: Principles of Physical Education, Philadelphia: Kea and febiger1983.
2. Bucher, Charles A. Foundation of Physical Education St. Louis: The C.Va Mosby & Company, 1986.
3. Cassidy, r. Curriculum Development in Physical Education, New York: Harper & Company, 1986.
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7. National Plan of Physical Education in Recreation, Ministry of Education, Govt. of India, 1956.
8. Pape. L.A. and Means, L.E.A. Professional Career in physical Education, Englewood, Cliffs, N.J. Prentice Hall, Inc.1952.
9. Reports of Various committees in Education and Physical Education and Physical Education, Govt. of India
10. Underwood, Gordon, L. The Physical Education Curriculum in Secondary School: Planning and Implementation England: Taylor and Francis Ltd. 1983.
11. Will goose, C.E. Curriculum in Physical Education 3rd Ed. Englewood Cliffs., N.J. Prentice Hall,Inc.1979

Semester - III

Paper –9

Bio-Mechanics

Unit 1.

- Biomechanics and Kinesiology: Meaning, Nature and Importance.
- Principles of plane and axis. Various types of movements.

Unit 2. Kinetics and Kinematics

- Motion: Linear motion, Rotary motion, Angular Motion, Curvilinear motion, Motion of transition.
- Balance, Newton's Laws of Motion, Acceleration, Velocity and speed.
- Force, Work, Power and Energy, Weight and Projectile.
- Leverage-Principles and Types.

Unit 3.

- Friction-Resistance, Water and Air Resistance.
- Elasticity.
- Spin
- Centrifugal and centripetal force.

Unit 4.

- Mechanical Analysis of Motor Movements-Walking, Jumping, Running, Throwing, Catching,Holding, Climbing, Lifting, Swinging, Gliding, Pulling.

Unit 5. Mechanical Analysis of Sports Skills

- Athletics(Running, Jumping, Throwing)
- Swimming.
- Football.
- Basketball
- Volleyball.
- Cricket.

REFERENCE:

1. Bunn, Hohn W. Scientific Principles of Coaching (Englewood Cliffs, N.J.: Prentice Hall Inc.,1972).
2. Simonian Charles, Fundamentals of Sport Biomechanics (Englewood Cliffs, n.J.: Prentice Hall Inc.,1911).
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   (Philadelphia: W.E. Saunder Co., 1979).
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Semester - III

Paper – 10

Sports Management

Unit 1.

- Sports Management-Meaning, Definition, Importance, Principles and functions.

Unit 2. Administration-Meaning, Types.

- Administration of education department and its functions.
    a. School Games Federation of India.
    b. State Education Sports Wing-School Administration.
    c. Association of Indian Universities.
    d. University department of Physical Education.
    e. College Physical Education Department, Administration of non teaching department and its functions.
    f. Youth and Sports department
    g. SAI
    h. Indian Olympic Association, Indian Sports Associations.
    i. State Sports Department

Unit 3. Administration of Sports Facilities, Equipment's, Funds and Employees.

- Facilities: Administration, Types, Need, Purchase of Equipment's, Preparation of fields and maintenance, Indoor Facilities (Gym, Swimming pool).
- Equipment's: Importance, Types, Purchase, Maintenance, Stock maintenance and disposal.
- Funds: Objective of Budget, Principles of budget preparation, ideal budget, its uses.
- Employees Administration: Leadership, Principles ,Need, Teacher's training improvement program.

Unit 4. Planning and supervision in Physical Education.

- Principles of Lesson planning.
- Supervision-Definition, Nature, Scope, Principles, Duties of a supervisor, Qualities of a supervisor, Method and effective supervision.

Unit 5. Public Relations

- Definition, Objectives and Need.
- Principles
- Planning and administration of program of public relations.
- Mediums and agencies.
- Steps for effective and qualitative public relations.

REFERENCES:

1. Earl F. Zeigh & Gary W. Bowie. Management Competency Development in Sports and Physical Education., (Philadelphia: W. Lea and Febiger,1963).
2. Joseph Bucher and Earnest Kienige burg, Scientific Inventory Management (New Delhi: Prentice Hall of India Pvt. Ltd.,1968).
3. Ashton D. Administration of Physical Education for Women (NewYork:The Ronal Press Cl,1968).
4. Bucher C.A. Administrate on of Physical Education and Athletic Program(St. Louis: The C.V. Mosby Co., 1979),7th Edition.
5. Daughtrey G. and Woods J.B. physical Education and Intramural Programs, Organization and Administration (Philadelphia U.S.A. : W.B. Sounders Cp., 1976), 11thEd.
6. Ferry the C.E. and Duncan R.C. Administration of Physical Education (New York: Prentice Hall Inc.1951).

Semester - III

Paper – 11

Test, Measurement and Evaluation in Physical Education & Sports

Unit 1.

- Test, Measurement and Evaluation-Meaning, Definition and Importance. Modern Trends in Measurement and Evaluation.
- Test Evaluation-Criteria of Test Selection, Objectivity, Reliability, Norms of Validity.

a. Classification of tests-Standardized tests, Teacher made tests, Subjective and objective tests.

b. Construction of knowledge and skill tests.

c. Steps in construction of knowledge and skill tests.

Unit 2.

A. Physical Fitness and Motor Fitness Tests.

- AAHPER Youth Fitness Test.
- National Physical Fitness Test.
- Indiana Motor Fitness Test.
- Philip's JCR Test.

B. Common Motor Strength Tests.

- Baroni –Common Motor Strength test.
- Newton Motor Strength test.
- Cozen's athletic ability test.
- Mc.Cloy's General motor ability test.

C. Cardio vascular and Respiratory Tests.

- Harvard Step Test.
- Cooper's 12 min continuous run/walk test.
- Kraus-Weber strength test.
- Roger strength test.

Unit 3. Sports Skill tests: Need and Use.

- Badminton- Lockhart and McPherson Badminton skill test, Miller wall Volley test.
- Basketball-Johnson Basketball skill test, Beach Basketball skill test.

- Hockey-Harvan singh Hockey Test.
- Tennis- Dyer Tennis skill test, Hewitt Tennis skill test.
- Volleyball-Russell Lange test, Brady Volleyball Skill Test.
- Football-Mcdonald Football skill test, SAI Football skill test.

Unit 4. Socio and Psychological Tests.

- Mc.Cloys behavior rating scale.
- Cowell social behavior trend index.
- Peterson's Social capacity test.
- Swakhyal test.

Unit 5.

Anthropometric measurements.

- Equipments.
- Body Fat measurement, General body measurements.
- Body composition measurements.

References:

1. ACSM's Health / Fitness Facility Standards and Guidelines, New York: HumanKinetics,1992.
2. Barrow, Harold M. and McGhee, "Rosemary, A Practical Approach to Management inPhysical Education" Pniladelphia: Lea and Febiger 1979.
3. Clake, H. Harrison.: Application of Measurement to Health and Physical Education, New Jersey: Prentice Hall Inc.1976.
4. Edmund O. Acevedo and Michael A. Starks, Exercise Testing and Prescription labManual, USA: Human Kinetics Publishers,2003.
5. Safrit, Margaret J.: Introduction to Measurement in Physical Education and Exercise Science,St. Louis: Mosby,1995.

Semester - III

Paper – 12.1

Physical Fitness and Wellness. (Elective)

Unit 1. Meaning & Definition of Physical Fitness, Importance & Advantage of Physical Fitness.

- Concept of Fitness
- Health Related Fitness
- Skill Related Fitness

Unit 2.

- Principles of Exercises.
- Model Program
- Importance of gymnasium and health-clubs.
- Exercise guidance program for Children, youth and special age groups.
- Construction of appropriate exercise program.

Unit 3. Physical Fitness activities:

- Aerobics
- Water exercises.
- Neurological training.
- Agility and equilibrium training.
- Isometric training.
- Cycling.
- Ladder climbing.
- Treadmill.
- Walking
- Health advantages.

Unit 4.

- Planning for lifelong fitness program, Aims of fitness, Encouragement for health and prevention of diseases, Domestic exercise equipment's, Fitness program for handicapped and mentally retarded children, Exercise for adults.
- Management in physical fitness and stress, Concept of stress, Effect of exercises in stress

management, Time management.

Unit 5. Meaning and Definition of Wellness

- Components of Wellness
- Contribution of Behavior in Wellness
- Advantage of Wellness

References:

1. Anderson, B., Stretch Yourself for Health & Fitness, Delhi : UBSPD,2002.
2. Austin and Noble, Swimming For Fitness, Madras: All India Pub.,1997.
3. Bean,Anita,FoodForFitness,London:A&CBlock,1999.
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6. Difiore, Judy, Complete Guide to Postnatal Fitness, London : A & C Black,1998.
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13. Mcglynn, G., Dynamics of Fitness, Madison : W.C.B Brown,1993.
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17. Sharkey, B.J., Physiology of Fitness, Human Kinetics Book,1990.
18. Thani, Lokesh, Rules of Games and Games and Fitness, Delhi: Sports,2003.

Semester - III

Paper – 12.2 (Elective)

Gender, Disability & Inclusive Sport Education

Unit 1

- Defining Gender and features of gender inequality
- Gender inequality in Education in India
- Gender based violence as a development and rights challenge

Unit 2

- Historical roots of gender construction in India –patriarchy and its socio- cultural origins
- Impact of gender as a social construct.
- Gender roles and the female stereotype in India
- The Global Gender Equality Agenda

Unit 3

- Gender issues in access to education & physical education
- Quality of work and equal opportunity
- Gender in the physical education classroom and peer interactions
- Gender issues in participation in sports

Unit 4

- Constitutional provisions for education of women in India
- UEE and programs for education of women in India
- Gender and policy perspective
- Class and Inequality

Unit 5

- Definition, concept and importance of inclusive education.
- Historical perspectives on education of children with diverse needs.
- Difference between special education, integrated education and inclusive education.
- Advantages of inclusive sports education for all children.

- Educational approaches and measures for meeting the diverse needs
- Building inclusive learning friendly sports facilities, overcoming barriers for inclusion.
- Creating and sustaining inclusive practices.
- Role of teachers, parents and other community members for supporting inclusion of children with diverse needs for participation in sports.

References:

1. Chanana Karuna (ed) Socialization, Education and Women, Orient Longman, New Delhi,1988
2. Mandell, Nancy (ed), Feminist Issues: Race, Class and Sexuality, Prentice Hall, Ontario, 1995
3. Nambissan, Geeta B, Gender and Education: The Social Context of schooling Girl Children in India, 1995.
4. Erik Olin Wright, "From Paradigm Battles to Pragmatist Realism: toward saninte grated class analysis", New Left Review (forthcoming)
5. Daryl Glaser, "Class as a Normative Category: Egalitarian Reasons to Take It Seriously (With a South African Case Study)
6. Daryl Glaser, 'Should An Egalitarian Support Black Economic Empowerment?', Politikon, vol. 34,no. 2, 105-123,2007.
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8. Michael Marmot, Richard Wilkinson, Social Determinants of Health: The Solid Facts
9. Mel Kohn, Class and Conformity, excerpts
10. Mel Kohn and Carmi Scholar, Work and Personality, excerpts 11.Gomberg, How to make opportunity equal (Blackwell,2007)
12. Ainscow, M., Booth. T (2003): The Index for Inclusion: Developing Learning and Participation in Schools. Bristol: Center for Studies in Inclusive Education.
13. Ahuja. A, Jangira, N.K. (2002): Effective Teacher Training; Cooperative Learning Based Approach: National Publishing house 23 Dareyaganj, New Delhi110002.
14. Jangira N.K. and Mani, M.N.G. (1990): Integrated Education for Visually Handicapped, Gurgaon, Old Subji mandi, Academic Press.
15. Jha. M.(2002) Inclusive Education for All: Schools Without Walls, Heinemann Educational publishers, Multivista Global Ltd, Chennai, 600042,India.
16. Sharma, P.L. (1990) Teachers handbook on IED-Helping children with special needs N. C. E RT Publication.
17. Sharma P.L (2003) Planning Inclusive Education in Small Schools, R.I E. Mysore

Semester - IV
Paper – 13

Scientific Principles of Sports Training and Coaching

Unit 1. Sports Training:

- Definition and meaning of Sports Training and Coaching.
- Aims and objectives.
- Characteristics.
- Principles.

Unit 2. Training Load:

- Factors.
- Principles.
- Overload-Meaning, Reasons, Characteristics, Remedies to overcome overload.
- Adaptation Procedure-Meaning, Stages of Adaptation process.

Unit 3. Training of Motor Components:

- Strength-Meaning, Types, Characteristics, Principles of strength of training, Methods of strength training, Strength training for women and children.
- Endurance-Meaning, Types, Characteristics, Methods of Endurance training.
- Speed- Meaning, Types, Characteristics, Methods of speed training.
- Flexibility- Meaning, Types, Characteristics, Methods of flexibility training.
- Coordination- Meaning, Characteristics, Classification, Importance, Training methods of coordinative abilities.

Unit 4.

- Techniques- Meaning, Techniques of different games, Importance of training, Factors

Unit 5. Effects on training process, Correction of faults-Skill, Style and Technique.

- Tactics-Meaning, Aims, Training, Principles of preparation of tactics, Difference between tactics and strategy.

Planning of Training and Competition:

- Planning of Training- Meaning, Importance, Principles and Types.
- Periodization-Meaning, High Performance and Per iodization, Period and Types.
- Competition-Meaning, Importance, Scope, Methods, Frequency, Preparation of Competition.

REFERENCE:

1. Harre, Dietrich, Principles of Sports Training (Berlin:Sporulated,1982).
2. Dick W. Frank. sports Training Principles (London: Lepus Books,1980).
3. Jensen, R. Clayne, and Fisher A.G. Scientific Basis of Athletic conditioning (Philadelphia: Lea and Fibiger 1979), 2nd Edn.
4. Matvyew, L.P. Fundamental of sports Training (Moscow: Progress Publishers,1981).
5. Cratty, J. Brayant Perceptual and Motor Development in Infants and Children (N.J.: Englewood Cliffs, Prentice Hall, Inc.1979).
6. Singh, H. Sports Training, General Theory and methods (Partials: NSNIS,1984).
7. Bunn, J.W. : Scientific Principles of Coaching.
8. Morehouse and Rash : Scientific Basis of Athletic-Training.

Semester - IV

Paper – 14

Sports Medicine

Unit 1. Effecting training, Stages of Training

- Sports Medicine: Meaning, Definition, Aims, Objectives, Modern Concepts and Importance.
- Athletes Care and Rehabilitation: Contribution of Physical Education Teachers and Coaches.

Unit 2. Sports Injuries and Remedies:

- Injuries:
  a. General Injuries: Wound, Lesion, Contusion, Burn, Abrasion, Sprain, Strain, Fracture.
  b. Special Injuries: Injuries on Back, Abdomen, Thigh, Knee, Ankle, Feet, Legs.
- Reasons for Injuries, Preventive measures for injuries, Treatment for Rehabilitation.

Unit 3. Massage and various therapies:

- Hydrotherapy: Contrast Bath, Sauna bath, Water Massage, Whirlpool.
- Cryotherapy: Ice pack, Gel and chemical cold Pack, Ice Massage, melting ice cry therapy.
- Electrotherapy: Shortwave diathermy, Ultrasound, Electric moist heating pad, stimulant, Infrared, Ultraviolet electric waves.
- Exercise Therapy: Isotonic, Isometric, Is kinetic Exercise training.
- Massage: Meaning, Importance, need and Types.

Unit 4. Nutritional diet for athletes and drugs:

- Athlete Nutritional Diet – Factors effecting balance diet, Athlete's Diet for different sports and games, Malnutrition in athletes and it scare.
- Doping – Meaning, History, Definition, Classification, Types, Use of drugs and their side effects, Role of Coach and Managers in solving the problem of doping.

Unit 5. Women Athlete:

- Anatomical and Physiological differences.
- Health Problems: Menses, Pregnancy, Special problems.

References:

1. Ann. Lowlin. Women's Fitness Program Development Human, Kinetics.2002.
2. Bengt O. Eriksson et al, Sports Medicine, GuinnesPublication,1990.
3. Christine M. Drews, Physiology of Sports and Exercise, Human Kinetics, USA,1999.
4. David R. Mottran, Drugs in Sports (4th Ed) Routledge Taylor and Francis Group,2005.
5. Erikson, B.O. et al, Sports Medicine, Guiness Pub. Great Britain, 1990.
6. Jain, Rachna, Sports Medicine, KSK, New Delhi,2002.
7. Jeyaprakash, C. S., Sports Medicine, J.P. Brothers Pub., New Delhi,2003.
8. Khanna, G.L., Exercise Physiology & Sports Medicine, Lucky Enterprises, Delhi,1990.
9. Mathew D.K. & Fox E.L, Physiological Basis of Physical Education and Athletics, W.B. Saunders Co: Philadelphia,1971.
10. Pandey, P.K., Outline of Sports Medicine, J.P. Brothers Pub., New Delhi,1987.
11. Pandey, P.K.,Sports Medicine, Khel Sahitya Kendra, NewDelhi,1998.

Semester - IV
Paper – 15

Yogic Science and Naturopathy

Unit 1.

- Yoga-Meaning and Importance, Paths, Precautions, Difference between exercises and Yoga, Types of Asanas and Surya namaskara.
- Ashtang Yoga- Different types of Pranayama and its importance, Kriyas, Bandhas and Mudra sciences-Nadis: Chandranadi, Surya nadi and Agninadi.

Unit 2.

- Place of Shodhan karma in Yoga, Nature of Mechanical Shodhan karma and Classification.
- Different glands in yoga, effect of yoga on different systems, plexis, Kundlini, Scientific observations of Yogasana.

Unit 3.

- Yoga Philosophy, Philosophy of Sankhya yoga, Yoga Psychology, Yoga science of Vibhuti, Prana science of Yoga.
- Panchprana-Upprana and factors deciding pranayama.
- Asanas and Pranayama for therapy of various diseases, Inculcating spiritual values through pranayam.

Unit 4.

- Naturopathy-Meaning, History, Importance and Agencies.
- Principles of Naturopathy

Unit 5.

- Difference therapies done through Naturopathy.
- Shivambu method, Acupressure and Acupuncture methods, Magnetic therapy.

References:

1. Swami Kuvalayananda and S.L. Vinekar -Yogic Theraphy.
2. Asanas–Swami Kuvalayananda. Kaivalyadha, a, Lonavla.
3. Swami Kuvalayananda, Kaivalyadhama, Lonavla -Pranayama.
4. K. Chandrasekar - Sound Health Through Yoga by Prem KalyanPublications, Sedapatti, 1999.
5. Teaching Methods for – M.L. Gharote and Yogic Practive S.K. Ganguly, Kaivalyadhama, LonavlaM.L. Gharote- Applied Yoga–Kaivalyadhama, Lonavla.
6. Yogasanas :A Teacher's Guide– NCERT, New Delhi.
7. O.P. Tiwari- Asanas–Why? And How? – Kaivalyadhama, Lonvla.
8. R. Thirumalaisamy (1987) – Yoga for Good Health, Karaikudi Senthil Kumar publishers.

Semester - IV

Paper – 16.2 (Elective)

Philosophical Foundation and History of Physical Education& Sports

OR

Dissertation

Unit 1.

- Education
- Meaning, Definition, Aims and Objectives of Education.
- Meaning, Definition, Aim and Objectives of Physical Education and Relationship of Physical Education with General Education.
- Physical Education and Philosophy.

Unit 2.

- Psychological Basis of Physical Education
- Play and Theories of Play
- General Principles of Growth and Development
- Principles of Motor skill acquisition

Unit 3.

- Philosophies of Education as applied to Physical Education-Idealism, Naturalism, Realism, Pragmatism, Existentialism and Humanism.

Unit 4.

- Sociological Basis of Physical Education
- Socialization Process
- Social Nature of Man and Physical Activities, Sports as cultural heritage of mankind.
- Customs, traditions and Sports.

Unit 5.

- Physical Education in Ancient Greece, Rome, Germany, Sweden, Denmark, and Russia.
- Physical Education in India.
- Olympic Movement – Historical Development of Ancient and Modern Olympics.

References:

1. Jay Coackley Sports in Society: Issue & controversies (2007) McGraw Hill, New York
2. Shamshad Ahmed. Education in Physical Education Books (2005). Isha. New Delhi.
3. Syal, Meenu. Physical Education Sports and Games. Sports Publication, (2005). New Delhi
4. Davis, M. B.Physical Training in School. Sports Publication, (2004). New Delhi.
5. Shekar, C. K. Foundation of Physical Education and Sports. Khel Sahitya Kendra, (2004).New Delhi.
6. Jain, Anoop. Physical Education Foundation. Sports Publication, (2003). New Delhi.
7. Wuest, Deborah A. Foundation of Physical Education, Exercise Science and sports. McGraw Hill,(2003). New York.
8. Jain, D. Physical Education for Secondary School Children. Khel Sahitya Kendra,(2003). NewDelhi.

DR. BHIMRAO AMBEDKAR UNIVERSITY AGRA
SCHOOL OF LIFE SCIENCES

Master in Faculty (Life Science)
(Bachelor Research)

Semester Wise Syllabus of the Papers for M.Sc. Biotechnology

DEPARTMENT OF BIOTECHNOLOGY

SUBJECT: BIOTECHNOLOGY
FACULTY OF LIFE SCIENCE

PROPOSED PAPERS AND SYLLABUS FOR CORE/ELECTIVE COURSES
(Based on Choice Based Credit System)
Under NEP-2020

Choice Based Credit System (CBCS)
Department of Biotechnology,
School of Life Sciences,
Dr. Bhimrao Ambedkar University, Agra

Core Courses	Course Title M.Sc. Biotechnology I semester	Marks		Total 100	Credit	Course Mapping		
		CIE	End Semester Examination			EC	EPC	SDC
BT-C101	Cell Biology	25	75	100	4	-	-	-
BT-C102	Biomolecules and Basic Enzymology	25	75	100	4	-	-	-
BT-C103	Microbial Physiology and Metabolism	25	75	100	4			
BT-C104	Biostatistics and Computer Application	25	75	100	4			
BT-C105	Practical		100	100	4			
	Industrial training/Survey/Research Project							
	Total			**500**	**20**			
Core Courses	**Course Title M.Sc. Biotechnology II semester**	**Marks**		**Total**	**Credit**	**Course Mapping**		
		CIE	**End Semester Examination**			**EC**	**EPC**	**SDC**
BT-C 201	Molecular Biology	25	75	100	4			
BT-C202	Instrumentation and Techniques in Biotechnology	25	75	100	4			
BT-C203	Biology of the immune system	25	75	100	4			
BT-C204	Genetics	25	75	100	4			
BT-C 205	Practical		100	100	4			
BT-C206	**Industrial training/Survey/Research Project**		200	**200**	**8**			
	Minor	25	75	**100**	**4**			
	Total			**800**	**32**			
Core Courses	**Course TitleM.Sc. Biotechnology III semester**	**Marks**		**Total**	**Credit**	**Course Mapping**		
		CIE	**End Semester Examination**			**EC**	**EPC**	**SDC**
BT-C301	Animal Cell science and technology	25	75	100	4			
BT-C302	Genetic engineering	25	75	100	4			
BT-C303	Bioprocess engineering and Technology	25	75	100	4			
BT-E304	Basic Bioinformatics	25	75	100	4			
BT-E305	Basic Genomics and Proteomics							
BT-C306	Practical		100	100	4			
	Industrial training/Survey/Research Project							
	Total			**500**	**20**			
Core Courses	**Course Title**	**Marks**		**Total**	**Credit**	**Course Mapping**		
		CIE	**End Semester Examination**			**EC**	**EPC**	**SDC**
BT-C401	Plant Biotechnology	25	75	100	4			
BT-C402	Environmental Biotechnology	25	75	100	4			
BT-E403	Molecular Diagnostics	25	75	100	4			
BT-E404	Stem Cell Biology							
BT-E405	Food Biotechnology	25	75	100	4			
BT-E406	Agricultural Biotechnology							
BT-C407	Practical		100	100	4			
BT-C408	**Industrial training/Survey/Research Project**		200	**200**	**8**			
	Total			**700**	**28**			
	Grand Total of 1st and 2nd year (I, II, III and IV semester)			**2500**	**100**			

Note: The I and II semesters of the first year of the M. Sc. Biotechnology in Faculty of Life Science Programme will be Known as VII and VIII semester of the B. Sc. Research (in Faculty of Life Science).

*** Courses Code having 'C' abbreviation is Core course and having 'E' abbreviation is Elective course.***

No. of Total Courses - 26,

Mapping of the course to employability/ Entrepreneurship/skill development :

***EC:** **Employability Courses** ***EPC:** **Entrepreneurship Courses** ***SDC:** **Skill Development Courses**

Mapping of the course to Local/ Regional/National/Global need：

***Loc:** Local Need ***Reg:** Regional Need ***Nati :** National Need ***Glob:** Global Need

Programme Educational Objectives (PEOs)

M.Sc. Biotechnology Program

The Program Educational Objectives (PEOs) for the M.Sc. Biotechnology program describe accomplishments that graduates are expected to attain within two years after graduation

PEO-1: To enable students to pursue research career in industry and academia by providing fundamental and practical knowledge in the field of Biotechnology.

PEO-2: To empower the students with analytical and research skills, enable them to critically analyze existing literature in an area of specialization and to nurture entrepreneurial endeavors.

PEO-3: To develop biotechnologists with professional ethics in order to address global and societal issues for sustainable development.

Programme Outcomes (POs)

The students of M. Sc. Biotechnology program will be able to:

PO-1: ***Sound knowledge of Science Area:*** To solve the biological problems by developing the new tools of diagnosis of various diseases and use of GMOs in various industries through good knowledge of biotechnology, microbiology, genetic engineering, molecular biology and bioinformatics

PO-2: ***Problem analysis:*** Identify, formulate, review research literature, and analyze complex biological problems reaching substantiated conclusions using various principles of biotechnology, bioinformatics, microbiology, biochemistry, cell and molecular biology sciences.

PO-3: ***Design/development of solutions:*** Design solutions for complex biological problems and design protocols or processes that meet the specified needs with appropriate consideration for the public health and safety, conservation of biodiversity, better understanding of the microorganisms, and using bioinformatics tools for finding solutions of various crippling human/plant diseases with ethical, societal, and environmental considerations.

PO-4: ***Modern Molecular Biology and Bioinformatics tools usage:*** Develop new technologies, protocols, resources, using modern molecular biology, biotechnology and bioinformatics tools and apply it to solve complex human health problems, plant stress tolerance and conserve endangered medicinal plants.

PO-5: ***Post Graduate Student and society:*** Apply the classic and modern biological theoretical and practical knowledge gained to address societal, health, microbial and plant biodiversity studies, safety, ethical and cultural issues and the consequent responsibilities relevant to the professional upgradation of the student and society as a whole.

PO-6: Skill development: An ability to acquire the skills in handling scientific instruments, planning and performing in laboratory experiments to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability in biotechnology

PO-7: ***Environment and sustainability:*** The professional PG students will have a better understanding of societal and environmental concerns, and demonstrate their knowledge, and need for sustainable development.

PO-8: ***Ethics:*** Apply ethical principles established by different government agencies and commit to research ethics, responsibilities and norms to undertake their current and future research and development.

PO-9: ***Individual and team work:*** Be an independent thinker and researcher effectively as an individual, and as a member or leader of different teams, and in multidisciplinary research Institutions and Universities.

PO-10: ***Communication:*** Communicate effectively on complex research activities with the scientific community and with society at large, as a scientist or a teacher, be well versed with scientific writing and write effective reports and design research projects, make effective presentations, and be able to defend it efficiently.

PO-11*: Life-long learning:* Apply the discipline, ethics and knowledge obtained to engage in independent and life-long learning in their respective fields of interest wherever they go for further higher studies or jobs.

Programme Specific Outcome (PSOs)

After the successful completion of M.Sc. Biotechnology program, the students will able to:

PSO-1: The objective of the Master's Programme in Biotechnology is to equip the students to apply knowledge of living organisms and their cellular processes, classification and interaction among themselves, with physical and chemical agents and higher order organisms. Have advanced understanding of Biotechnology in its various domains including, health, nutrition, agriculture, biodiversity conservation, Biosafety etc.

PSO-2: The laboratory training in addition to theory is included to prepare them for careers in the industry, agriculture, and applied research where biological system is increasingly employed. Address research questions related to all the above mentioned domains through carrying out specific experiments.

PSO-3: Basics and current molecular updates in the areas of Industrial Biotechnology, Fermentation Technology, Agriculture and Environmental Biotechnology are included to train the students and also sensitize them to scope for research.

PSO-4: The study of Master of Biotechnology will impart in-depth understanding of basic aspects of Biotechnology pertaining to industrial applications that will make the students ready to contribute to:

- ✓ Better awareness of the major issues at the forefront of the discipline.
- ✓ Will possess an in-depth understanding of the area of Biotechnology chosen for research emphasis.
- ✓ Awareness of ethical issues in Medical, clinical and animal research and careers options.

PSO-5: Appear and successfully qualify the higher level examinations of various agencies like DBT (Department of Biotechnology), CSIR (Council of Scientific and Industrial Research), ARS (Agriculture Research Services), ICAR (Indian Council of Agriculture Research), and many more, so as to get chance to do research from reputed institutes within country and abroad with sound fellowships.

PSO-6: Develop inclination towards own professional goals over a wide range of carrier options expanding from R & D, industries or as an Entrepreneur.

M. Sc. Biotechnology I semester

Core Course : BT-C101, Title: Cell Biology

[Total Credits : 04; Total Marks= 100; CIE= 25; End Semester Exam= 75]

Course Objectives: This course enable students to learn fundamental principles of various cellular concepts such as cell structure and transport, Cell communication, cell cycle and cell death pathway, cell differentiation and expression.

Topics	Teaching Hrs.
Unit I	
1. Plasma Membrane: Composition and structure, membrane proteins, lipid and carbohydrates, endo- and exocytosis. 2. Transport of small molecules across cell membrane: Types and mechanism. 3. Active transport by ATP powered pumps types: P type, V Type, F type and ABC transporters. 4. Cell motility: Structure and function of microfilaments and microtubules.	**15**
Unit II	
1. Structure of Mitochondria and cellular energy transaction by oxidative phosphorylation, 2. Structure of chloroplast and cellular energy transaction by photophosphorylation 3. Nucleus : Nuclear envelope, nuclear pore, nucleolus and chromosomes. 4. Cell organelles and Secretions : Golgi complex, endoplasmic reticulum, lysosomes and peroxisomes.	**15**
Unit III	
1. Cell Signaling : Paracrine, Endocrine, Autocrine. Signaling molecules – hormones, neurotransmitter, proteins and environmental factors.Cell surface receptors - G protein coupled receptor, receptor protein tyrosine kinase, cytokine receptor and non-receptor protein tyrosine kinase, receptor linked to other enzymatic activities. 2. Signaling pathways : Cyclic AMP pathway (second messenger and protein phosphorylation), cyclic GMP pathway, phospholipids and Ca^{2+} pathway, Ras-Raf and MAP kinase pathway, JAK/STAT pathway, 3. Apoptosis – Programmed cell death, apoptotic pathways and regulation. 4. Biology of cancer, difference between normal and cancer cells	**15**
Unit IV	
1. Molecular events of cell cycle 2. Components in cell cycle control – cyclin, CDKs, Check points in cell cycles, G0 to G1 transition, G1 – S transition, S – G2 Transition, G2 – M Transition, events of M phase, The spindle assembly checkpoints leading to anaphase. 3. DNA damage checkpoints by p53 protein, regulation of cell division. 4. Spatial and temporal regulation of gene expression. 5. Cellular Differentiation in Drosophila	**15**

Suggested reading

1. Molecular Biology of the Cell (2002), Alberts et al
2. Molecular Cell Biology (2004), Lodish et al
3. Working with Molecular Cell Biology: A study Companion (2000), Storrie et al
4. Cell and Molecular Biology: Concepts and Experiments (3rd Ed., 2002), Gerald Karp
5. The Cell: A Molecular Approach (2004), G.M. Cooper
6. The Word of the Cell (1996), Becker et al
7. Cell Proliferation and Apoptosis (2003), Hughes and Mehnet
8. Essential Cell Biology (1998), Alberts et al
9. Biochemistry and Molecular Biology of Plants (2000), Buchanan et al
10. Harpers Biochemistry Murray et al

Course Outcomes :

After completing this course, student is expected to learn the following:

CO1: Earn how the organic and inorganic ions transport across the cell membrane and how electrical signals are carried to target cells. **U**nderstand the role of cytoskeleton and it's remodeling.

CO2: Learn different areas of cell biology including structure, energy transaction and function of cell organelles.

CO3: Understand the cell Signaling pathways, Programmed cell death and Cancer.

CO4: Able to explain the cell cycle and its regulation.

Course Mapping:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	3	3	1	1	3	-	-	-	3	3	3	3	2	1	2	2	-
CO2	3	3	1	1	3	-	-	-	3	3	3	3	2	1	2	2	-
CO3	3	3	1	1	3	-	-	1	3	3	3	3	2	1	2	2	-
CO4	3	3	3	1	3	-	-	1	3	3	3	3	2	1	2	2	-

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

M. Sc. Biotechnology I semester

Core Course : BT- C102, Title: Biomolecules and Basic Enzymology

[Total Credits : 04; Total Marks= 100; CIE= 25; End Semester Exam= 75]

Course Objectives: The course aims to provide students with an understanding of biomolecules, the basic building blocks of living organisms, focusing on their structural underpinnings, unique properties, biological roles and functions and inter relations. Emphasis will be on the association between structure and function of various biomolecules at a chemical level with a biological perspective.

TOPIC	Teaching Hrs.
Unit I	
1. Biomolecules – Chemical composition and bonding, three dimensional structure, configuration and confirmation. 2. Chemical reactivity – five general types of chemical transformation of : oxidation reduction reactions, nucleophilic substitution, electron transfer with in molecules producting internal rearrangement, group transfer reaction, condensation reaction 3. Water – weak interactions in aqueous system, ionization of water, weak acid and weak base, concept of pH & pKa, Buffers (bicarbonate buffering system). 4. Principles of Bioenergentics – Entropy, enthalpy and free energy.	**15**
Unit II	
1. Carbohydrates: Classification, Structure, chemical feature and function. - Structure, properties and functions of homo and hetero polysachharides. - Blood groups and bacterial polysaccharides, Glycoprotein, Cardioglycosides 2. Lipids – Classification, Structure, chemical feature and function - Structure and properties of fatty acids, acyl glycerols, phosphor lipids, sphingolipids, glycolipids. - Structure and function of steroids, prostaglandins, thromboxanes and leucotrienes.	**15**
Unit III	
1. Amino acids, peptides and proteins - Classification, Reaction & physical properties. Elucidation of primary structure of proteins, secondary structure - α-helix, β-helix, triple helical structure. Ramachandran plot 2. Structure of insulin, ribonuclease, myoglobin, chymotrypsin. Quaternery structure – Hemoglobin , Protein denaturation, Protein Folding, Role of Heat Shock Proteins. 3. Nucleotides and nucleic acids: structure of nitrogenous bases, nucleosides, nucleotides	**15**
Unit IV	
1. Enzymes – Classification and factors affecting enzyme activity 2. Allosteric Enzymes and their regulation 3. Enzyme kinetics – Equilibrium and steady state theory (Michalis Menten equation) and determination of kinetic parameters. 4. Enzyme inhibition – reversible and irreversible inhibition, competitive, non-competitive and un-competitive inhibition	**15**

Suggested reading

1. Principles of Biochemistry by Nelson, Cox and Lehninger.
2. Biochemical Calculations, Irwin H. Segel, john Wiley and sons Inc
3. Biochemistry,DVoet and jGVoet , J Wiley and Sons
4. Laboratory Techniques in Biochemistry and molecular Biology, Work and Work
5. Principles of Biochemistry by A.L.Lehninger, 2 Ed. (worth).
6. Biochemistry by L.Stryer 5 Ed. (Freeman-Toppan).
7. Harper's Biochemistry (Langeman).
8. Enzymes by Palmer (East).

Course Outcomes :

After completing this course, student is expected to learn the following:

CO1: Remember the chemical basis of life, properties of biomolecules in water, importance of pH and biomolecular hierarchy. Able to analyse and apply the knowledge related to bioenergetics in living system.

CO2: Understand the classification, structure and biological importance of carbohydrates and lipids. Get an insight into the biochemical methods for the estimation of carbohydrates and lipids both quantitatively and qualitatively.

CO3: Able to analyse the classification, structure and function of proteins and nucleotides.

CO4: Learn the concepts of enzyme, its kinetics, regulation, specificity and other physiological reactions inside the cell.

Course Mapping:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	2	3	1	-	3	-	2	-	3	3	3	3	1	3	3	3	-
CO2	2	3	1	-	3	-	2	-	3	3	3	3	1	3	3	3	-
CO3	2	3	1	1	3	-	2	-	3	3	3	3	1	3	3	3	-
CO4	2	3	1	-	3	-	2	-	3	3	3	3	1	3	3	3	-

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

Employability

M. Sc. Biotechnology I semester

Core Course : BT- C103: Microbial Physiology and Metabolism

[Total Credits : 04; Total Marks= 100; CIE= 25; End Semester Exam= 75]

Course Objectives : The objective of the course is to make the students to understand the basic concepts of the microbial growth, nutrition habit of microorganisms and various type of media. To learn the microbiological techniques used for the classification, isolation, purification of microorganisms and microbial metabolism.

Topics	Teaching Hrs.
Unit I	
1. Development of Microbiology in twentieth century 2. General characteristics of prokaryotes, cynobacteria, Viruses, Viriods and Prions. 3. Methods of Pure culture techniques, Theory and practice of sterilization, Construction of culture media, enrichment culture techniques for isolation of chemoautotrophs, chemoheterotrophs and photosynthetic microorganisms. 4. Microbial Systematic and Taxonomy New approaches of bacterial taxonomy, classification including ribotyping, ribosomal RNA sequencing.	**15**
Unit II	
1. Overview of Microbial nutrition. 2. Metabolic diversity among Microorganisms - Photosynthesis in microorganisms; Role of chlorophylls, Carotenoids and phycobilins. - Chemolithotrophy: Hydrogen-ion-nitrate-oxidizing bacteria; nitrate and sulfate reduction. - Methanogenesis and acetogenesis: fermentation's-diversity. Homo and Heterolactic Fermentation. - Role of anoxic decompositions: nitrogen metabolism, nitrogen fixation; hydrocarbon transformation. 3. Microbial Growth The definition of growth; mathematical expression of growth; growth curve; measurement of growth and yields; Synchronous growth; Growth as affected by environmental factors likes temperature; acidity; alkalinity water availability and oxygen	**15**
Unit III	
1. Carbohydrate Catabolism: Glycolysis, Citiric acid cycle, Pentose phosphate pathway, Embeden Mayerhoff pathway. 2. Lipid Catabolism –Oxidation of fatty acids. 3. Amino acid oxidation and production of Urea. 4. Oxidative and Photophosphorylation, ATP Production	**15**
Unit IV	
1. Carbohydrate Anabolism – Gluconeogensis, glyoxalate pathway and regulation. 2. Lipid Biosynthesis 3. Biosynthesis of Amino acids – tryptophan, alanine, cysteine, histidine, glutamate 4. Biosynthesis of nucleotides and poly amines	**15**

Suggested reading

1. Microbiology, Pelczar, M.J., Chan E.C.S. and Kreig, N.R., Tata McGraw Hill.
2. Microbiology by Tortora, Funk & Case.
3. Microbiology by Prescott.

Course Outcomes :

After completing this course, student is expected to learn the following:

CO1: Explore the fascinating world of microorganism and their role (both beneficial and harmful) in day to day life. It imparts knowledge on the various phases and contribution of different Scientists how Microbiology established itself as a separate branch of Science. Theoretical knowledge of microbial diversity & systematics, Experimental knowledge of Sterilization, disinfection, safety in microbiological laboratory. Preparation of media, Isolation and maintenance of organisms by plating, Streaking and Serial dilution methods, Gram Staining and enumeration of microorganisms. Demonstrate the practical skills in basic microbiological techniques.

CO2 : Able to analyse the growth pattern and nutrition type of microbes. Get an insight on the existence of microbes in different spheres of the environment and how the microbes are affected/induced in these environments or vice versa.

CO3: Knowledge and understand the catabolic pathways, principles and metabolic regulation of biochemical processes. Advanced knowledge of synthesis and catabolism of major biomolecules.

CO4: Understand the anabolism and biosynthesis of lipids, amino acids and nucleic acids and their role in biological systems. Comprehensive knowledge to distinguish between different metabolic processes and their impact in metabolism of biomolecules.

Course Mapping:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	3	2	3	1	3	-	3	-	3	2	3	3	2	2	2	2	1
CO2	3	2	3	1	3	-	3	-	3	2	3	3	2	2	2	2	1
CO3	3	2	3	1	3	-	3	-	3	2	3	3	2	2	2	2	1
CO4	3	2	3	1	3	-	3	-	3	2	3	3	2	2	2	2	1

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

Employability and Skill Development

M. Sc. Biotechnology I semester

Core Course : BT-C104: Biostatistics and Computer Application

[Total Credits : 04; Total Marks= 100; CIE= 25; End Semester Exam= 75]

Course objectives: This course enables students to learn basic concepts of biostatistics, sampling, distribution and presentation, hypothesis testing, design, correlation and regression analysis, statistical methods. To provide basic knowledge of computers.

Topics	Teaching Hrs.
Unit I	
1. Brief description, classification, tabulation of data and its graphical representation 2. Measures of central tendency and dispersion mean; median; mode range. Standard division, variance. 3. Simple linear regression and correlation. 4. Probability, Theorems of probability and probability distribution – Bionomial, Poission and Normal distribution	**15**
Unit II	
1. Test of significance; null hypothesis, alternative hypothesis, two types of errors, Level of significance 2. T test, Comparison of means of two samples (equal and unequal) 3. ANOVA : Comparison of means by three or more samples (a). Analysis of variance in one way classification (one factor analysis). (b). Analysis of variance in two way classification (two factor analysis). 4. Chi Square test: Goodness of Fit, Independence of attributes	**15**
Unit III	
1. Classification of Computers: Notebook, Personal computers, Workstation, Main frame system, Supercomputers 2. Introduction of digital computers organization, low level and high level language. 3. Number systems : Positional and non Positional 4. Binary, Octal and Hexadecimal number system. 5. Computer Codes: BCD code, EBCIDC, Zoned and Packed Decimal Number	**15**
Unit IV	
1. Flow chart and programing techniques 2. Introduction to Business data processing: Data storage Hierarchy, The standard methods of organizing data, file management system and data based management system 3. Introduction to MS-office software, covering Word processing. spreadsheets and presentation 4. Introduction to internet and its application.	**15**

Suggested reading

1. Wayne W. Daniel, Biostatistics: A foundation for Analysis in the Health Sciences, 8th Edition, Wiley.
2. Prem S. Mann, Introductory Statistics, 6th Edition, Wiley, 2006.
3. John A. Rice, Mathematical Statistics and Data Analysis, 3rd Edition, John A. Rice, Duxbury Press.
4. Campbell and Heyer, Discovering Genomics, Proteomics, & Bioinformatics, 2nd Edition, Benjamin Cummings, 2002.
5. Cynthia Gibas and Per Jambeck, Developing Bioinformatics Computer Skill, 1st Edition, O'Reilly Publication, 2001.
6. Computer Fundamental by Pradeep K Sinha and Priti Sinha third Edition BPB publication 2003

Course Outcomes : **After completing this course, student is expected to learn the following:**

CO1: Able to analyze and apply the basics of biostatistics for easy interpretation and representation of data. Gain knowledge about Measures of Central tendency, Dispersion and Probability.

CO2: Theoretical and Practical knowledge of application of correlation and regression analysis, test of significance: F and t tests, Chi square test etc. To collect data relating to variables which will be examined and calculate descriptive statistics from these data.

CO3: Provide knowledge of basic principles and concepts of computers existing software to extract information and Basic idea of computer languages, number system and codes.

CO4: Familiarization with data processing, MS office, internet and its applications.

Course Mapping:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	1	3	-	-	-	3	-	-	3	3	2	-	1	2	1	1	-
CO2	1	3	-	-	-	3	-	-	3	3	2	-	1	2	1	1	-
CO3	1	3	-	-	-	3	-	-	3	3	2	-	1	2	1	1	-
CO4	1	3	-	-	-	3	-	-	3	3	2	-	1	2	1	1	-

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

Skill Development

M. Sc. Biotechnology I semester

Core Course : BT-C105: Practical

[Total Credits : 04; Total Marks= 100; End Semester Exam= 100]

Course objectives: This course enables the students to learn the Basic principles, Instrumentation and applications of tools and techniques used in biotechnology lab. The student will also learn the statistical principles to apply in an experiment designing.

Topics	Teaching Hrs.
1. To study the Basic principles, Instrumentation and applications of Hot Air Oven. 2. To study the Basic principles, Instrumentation and applications of Autoclave. 3. To study the Basic principles, Instrumentation and applications of Centrifuge. 4. To study the Basic principles, Instrumentation and applications of Laminar Air Flow. 5. To study the Basic principles, Instrumentation and applications of Water Bath. 6. To study different stages of meiosis in onion bud. 7. To study different stages of mitosis on onion root tip. 8. To perform vital staining of mitochondria of plant/animal cell. 9. To identify the presence of protein in different samples. 10. To identify the presence of cholesterol/lipid molecules. 11. To identify the presence of sucrose/carbohydrate molecules 12. To prepare the buffer at required pH (Sodium /potassium phosphate buffer). 13. To prepare nutrient broth and nutrient agar plates for bacterial growth. 14. To prepare serial dilution of soil samples for isolation microbes. 15. To isolate bacteria by using pour- plate method. 16. To isolate bacteria by using spreading method. 17. To isolate bacteria by using streaking method. 18. To prepare different reagents of Gram staining method. 19. To detect gram - positive and – negative bacteria by using Gram staining methods. 20. To prepare Potato Dextrose Agra (PDA) for fungal growth. 21. To stain fungi using Lacto phenol Cotton Blue. 22. To perform Acid Fast staining with given samples. 23. To study and perform of T-Test with given samples. 24. To study and perform of χ^2 -Test with given samples.	

Suggested reading

1. Biotechnology Department Practical Manual
2. Wilson Walker Practical Biochemistry
3. Laboratory Manual for Biotechnology by Ashish Verma et al, S chand Publication

Course Outcomes : After completing this course, student is expected to learn the following:

CO1 : To develop practical skills on sterilization, pure culture techniques and identification biomolecules.

CO2 : To understand the working and handing of laboratory instruments.

CO3 : To gain knowledge for cultivation of microorganism.

CO4 : To develop skills for analysis of data/ population samples.

Course Mapping:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	3	3	3	1	2	3	3	-	3	2	3	1	3	1	-	1	1
CO2	3	3	3	1	2	3	-	-	3	2	3	1	3	1	-	1	1
CO3	3	3	3	1	2	3	3	-	3	2	3	1	3	1	-	1	1
CO4	3	3	3	1	2	3	-	-	3	2	3	1	3	1	-	1	1

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

Employability

M. Sc. Biotechnology II semester

Core Course : BT-C201: Molecular Biology

[Total Credits : 04; Total Marks= 100; CIE= 25; End Semester Exam= 75]

Course Objective: The objective of the course is to understand the principles and techniques of molecular biology

The students will learn the concept of gene, modulation of gene its regulation, modes of transmission including advanced knowledge in a specialized field of molecular biology\

TOPIC	TEACHING HOURS
Unit I 1. Introduction of molecular biology and genetics. 2. Genome organization – genome, c-value, c-value paradox, genome complexity, 3. DNA Replication Prokaryotic and eukaryotic DNA replication, mechanism of DNA replication, enzymes and accessory proteins involved in DNA replication.	**15**
Unit II 1. Transcription Prokaryotic transcription and eukaryotic transcription, RNA polymerase, General and specific transcription factors, regulatory element and mechanisms of transcription regulation. 2. Transcriptional and post transcriptional gene silencing. 3. Modification of RNA 5'-cap formation, transcription termination, 3' end processing and polyadenylation, splicing, Editing, Nuclear export of mRNA, mRNA stability.	**15**
Unit III 1. Translation Prokaryotic and eukaryotic translation, the translation machinery, mechanisms of initiation, elongation and termination, regulation of translation. **2.** Co- and Post- translational modifications of proteins.	**15**
Unit IV 1. Protein localization and transport Synthesis of secretary and membrane, import into nucleus. Mitochondria E. R., Golgi complex, chloroplast, and peroxisomes, Receptor mediated endocytosis. 2. Antisense and ribozyme technology Molecular mechanism of antisense molecules, inhibition of splicing, polyadenylation and translation. Disruption of RNA structure and capping biochemistry of ribozyme; hammerhead, hairpin and other ribozymes, strategies for designing ribozyme, application of antisense and ribozyme technologies.	**15**

Suggested Books:

1. Lodish et al., Molecular cell Biology, 4th Edition, W.H. Freeman & Company, 2000.
2. Smith & Wood, Cell Biology, 2nd Edition, Chapman & Hall, London, 1996.
3. Watson et al., Molecular Biology of the gene, 5th Edition, Pearson Prentice Hall. USA, 2003.
4. B. M. Turner, Chromatin & Gene regulation, 1st Edition, Wiley-Blackwell, 2002.
5. Benjamin Lewin, Gene X, Edition, Jones and Barlett Publishers, 2007.
6. Alberts et al; Molecular Biology of the Cell, 4th edition, Garland, 2002.
7. Recombinant DNA technology by Watson et. al., (Scientific American Books).
8. Principles of Gene Manipulation by Old and Primrose.(Blackwell).
9. Molecular Biotechnology by Glick.

Course Outcomes : **After completing this course, student is expected to learn the following:**

CO1: Advanced understanding of fundamental concepts of molecular biology and genetics. Improved understanding of molecular basis of genome organization and function. Develop deep understanding of mechanism of DNA replication.

CO2: Understand mechanism of transcription in prokaryotes and eukaryotes. Enhance fine molecular understanding of operon gene regulation ion in prokaryotes. Develop understanding of the molecular basis of gene silencing and RNA processing.

CO3: Knowledge of mechanism of translation and Co- & post- translation modification in prokaryotic and eukaryotic system. To get an insight in to the wide range of mechanisms required for gene regulation in different organisms.

CO4: Ability to understand the protein localization in various organelles and learn the molecular mechanism of antisense and ribozyme technology.

Course Mapping:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	3	3	3	3	3	2	1	-	2	3	3	3	3	3	3	2	-
CO2	3	3	3	3	3	2	1	-	2	3	3	3	3	3	3	2	-
CO3	3	3	3	3	3	2	1	-	2	3	3	3	3	3	3	2	-
CO4	3	3	3	3	3	2	1	-	2	3	3	3	3	3	3	2	-

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

Employability and Skill Development

M. Sc. Biotechnology II semester

Core Course : BT-C202 : Instrumentation and Techniques in Biotechnology

[Total Credits : 04; Total Marks= 100; CIE= 25; End Semester Exam= 75]

Course Objectives: To introduce the learner to the basic concept of qualitative and quantitative analysis of various biological samples. Students would be taught about the biophysical and biochemical techniques currently available to investigate the structure and function of the biological macromolecules. Learner would be made aware about the various separation techniques and its instrumentation, principles behind each technique, make them familiar with various methods of analysing the output data and to build a strong foundation in the area of Biotechnology.

Topics	Teaching Hrs.
Unit I	
1. Photometry – Basic principles, Instrumentation and applications of UV-Visible spectrophotometry 2. Infrared (IR) spectroscopy and its applications 3. Fluorescence spectroscopy – principle, instrumentation and applications. 4. Mass spectroscopy – Mass analyzers, principle, instrumentation and applications.	**15**
Unit II	
1. Raman spectroscopy and its applications 2. Electron spin resonance (ESR) spectroscopy and applications 3. Nuclear magnetic resonance (NMR) Spectroscopy – principle, instrumentation and applications 4. Circular Dichroism (CD) spectroscopy – principle, instrumentation and applications 5. X-ray Crystallography – principle, instrumentation and applications	**15**
Unit III	
1. Centrifugation – basic principle, types and applications 2. Chromatography: Principle, types and applications of Paper, Thin layer, High performance liquid chromatography; Column Chromatography – Gel filtration, Ion exchange chromatography, affinity chromatography, adsorption chromatography. 3. Electrophoresis: Principle, types and applications; Agarose gel, PAGE, SDS-PAGE, Iso-electric focusing, Two Dimensional gel electrophoresis, Immuno-electrophoresis, Capillary electrophoresis, Pulse Field gel electrophoresis. 4. Autoradiography – Principle and applications, radioisotopes used in biology and their application.	**15**
Unit IV	
1. Microscopy – Basic principle and components of microscope, phase contrast and fluorescent and Confocal microscopes 2. Electron microscopy – principle and applications 3. Sequencing techniques for proteins and nucleic acids 4. Detection of molecules using flow cytometry and *in-situ* localization by hybridization techniques such as FISH and GISH	**15**

Suggested reading

1. Biochemical Techniques : Theory and Practice by Robyt and White
2. Principles of Instrumental Analysis by Skoog and West
3. Analytical Biochemistry by Holme and Peck
4. Biological Spectroscopy by Campbell and Dwek
5. Organic Spectroscopy by Kemp
6. A Biologist's Guide to Pronciples and Techniques of Practical Biochemistry by Wilson and Goulding

7. Principles of Instrumental Analysis by Skoog, Hollar and Nicman
8. Physical Biochemistry: Applications to Biochemistry and Molecular Biology by Freifelder
9. Hawk's physiological chemistry Ed. by Oser (McGraw Hill).
10.Biochemical methods By Sadasivam and Manikam (Wiley Eastern limited).
11. An introduction to practical biochemistry by D.T.Plummer (McGraw Hill).
12. Laboratory manual in Biochemistry by J.Jayaraman (Wilety Eastern limited).
13. Biochemistry - a laboratory courses by J.M.Beckar (Academic Press).
14. Manual of clinical laboratory immunology by Rose NR.
15. The experimental foundations of modern immunology by Clark W.R.
16 Practical Biochemistry, by Wilson Walker

Course Outcomes : **After completing this course, student is expected to learn the following:**

CO1: Understand and interpret the basic principles, Instrumentation and applications of UV-Visible spectrophotometry, Infrared (IR) spectroscopy, Fluorescence spectroscopy, Mass spectroscopy.

CO2: Gain knowledge of principle, instrumentation and applications Raman spectroscopy, Electron spin resonance (ESR) spectroscopy, Nuclear magnetic resonance (NMR) Spectroscopy, Circular-Dichroism (CD) spectroscopy, X-ray Crystallography.

CO3: Understand and Interpret the Basic Principle, Types and Applications of Centrifugation, Chromatography, Electrophoresis, Autoradiography. It also helps students to develop the idea of separation of plant pigments and amino acids using chromatographic methods and determine the tissue (or cell) localization of a radioactive substance.

CO4: Remember the basic principle and components of Microscopy, process of sequencing techniques for proteins and nucleic acids, interpret and analyzed the molecules using flow cytometry and *in-situ* localization by hybridization techniques such as FISH & GISH

Course Mapping:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	3	3	3	3	-	3	-	-	2	3	3	-	3	2	3	2	2
CO2	3	3	3	3	-	3	-	-	2	3	3	-	3	2	3	2	2
CO3	3	3	3	3	-	3	-	-	2	3	3	-	3	2	3	2	2
CO4	3	3	3	3	-	3	-	-	2	3	3	-	3	2	3	2	2

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

Employability

M. Sc. Biotechnology II semester

Core Course : BT-C203:Biology of Immune System

[Total Credits : 04; Total Marks= 100; CIE= 25; End Semester Exam= 75]

Course Objectives: The objective of this course is to provide a detailed overview of immune system to the learners. The learner will understand structure, organization and functions of various components of the immune system like antigen, antibody, organs, MHC, cytokines and others in the defence system of the body. It would also make them understand the concepts of innate and adaptive immunity, immune diversity and specificity, autoimmunity, hypersensitivity, transplantation and others.

Topics	Teaching Hrs.
Unit I	
1. Immune response: innate and adaptive immune system, cells and molecules of immune system, Cells of the Immune system : Hematopoiesis and differentiation , Lymphocyte trafficking , B-lymphocyte , Macrophage Dendritic cells , Natural killer and Lymphokine activated killer cells, Eosinophils , Neutrophils and Mast cells . 2. Clonal selection theory. 3. Organization and structure of lymphoid organ. 4. Nature and biology of antigens and super antigens. 5. Antibodies structure and function.	**15**
Unit II	
1. Antigens antibody interactions. 2. Major histocompatibility complex. 3. BCR & TCR, generation of diversity. 4. Regulation of immune response: - Antigen processing and presentation , generation of humoral and cell mediated immune response . - Activation of B & T –lymphocytes. - Cytokines and their role in immune regulation. - T-cell regulation, MHC restriction. - Immunological tolerance.	**15**
Unit III	
1. Complement system. 2. Cell mediated cytotoxicity: Mechanism of T cell and NK cell mediated lysis, Antibody dependent cell mediated cytotoxicity, macrophage mediated cytotoxicity. 3. Hypersensitivity. 4. Autoimmunity	**15**
Unit IV	
1. Transplantation 2. Immunity of infectious agents (intercellular, parasites helminthes & viruses) 3. Tumor Immunology. 4. AIDS and other Immunodeficiency. 5. Hybridoma Technology and monoclonal antibodies. 6. Catalytic antibodies	**15**

Suggested reading

1. Kuby, RA Goldsby, Thomas J. Kindt, Barbara, A. Osborne Immunology, 6th Edition, Freeman, 2002.
2. Brostoff J, Seaddin JK, Male D, Roitt IM., Clinical Immunology, 6th Edition, Gower Medical Publishing, 2002.
3. Janeway et al., Immunobiology, 4th Edition, Current Biology publications., 1999.
4. Paul, Fundamental of Immunology, 4th edition, Lippencott Raven, 1999.
5. Goding, Monoclonal antibodies, Academic Press. 1985.
6. Essentials of Immunology by Roit (ELBS).
7. Immunology by Roit et.al (Harper Row).
8. Text book of Immunology by S.T,Barrot (Mosby).
9. Principles of Microbiology and Immunology by Davis et.al., (Harper).

Course Outcomes : **After completing this course, student is expected to learn the following:**

CO1: Familiarize with the concept of non-specific (innate) and specific (acquired) resistance mechanism developed in human beings against pathogens and other non-self factors which is the basis of this course.

CO2. Get an insight into the formation, types, organization and functional specificity of different cellular and organ level components conferring resistance in human being. To understand the nature, types and function of antigens that induce immunological response in man and how the product of this response (antibody, B and T cells) help in neutralizing them (agglutination and precipitation reactions). To have the concept of different mediators/cell signaling molecules (cytokines: interferons, Interleukins and chemokines) associated with immunological responses as well as their biological consequences. Understanding the role of antibody/antigen in disease diagnosis. To deal with the different diagnostic and serological approaches for the study of interaction between an antigen and its specific antibody including Widal Test, immunodiffusion, Immuno-electrophoresis, ELISA and RIA.

CO3. Understand the concepts of Complement system; Cell mediated cytotoxicity, Hypersensitivity, and Autoimmune disorders.

CO4. Analyse the immune system in organ transplantation oncogenesis and immune deficiency and induced immunity to overcome such abnormalities.

Course Mapping:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	3	2	2	2	3	-	2	-	3	2	3	3	2	2	3	1	2
CO2	3	2	2	2	3	-	2	1	3	2	3	3	3	2	3	1	2
CO3	3	2	2	2	3	-	2	-	3	2	3	3	2	2	3	1	2
CO4	3	2	2	2	3	-	2	1	3	2	3	3	2	2	3	1	2

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

M. Sc. Biotechnology II semester

Core Course : BT-C204 : Genetics

[Total Credits : 04; Total Marks= 100; CIE= 25; End Semester Exam= 75]

Course Objectives: The objective of this course is to provide a detailed overview of DNA Damage and DNA repair. The student will able to learn the methods of gene mapping, molecular markers for genome analysis as well as new generation recombinant DNA vaccines

TOPIC	Teaching Hrs.
UNIT –I	
1. Gene as unit of mutation and recombination. 2. Molecular nature of mutations; mutagens. 3. Type of DNA damage (deamination, oxidative damage, alkylation, pyridine dimmers). 4. Ame's test for mutagenesis 5. DNA repair- photorepair, excision or dark repair, recombinational repair, SOS repair.	**15**
UNIT-II	
1. Methods of genetic analysis and genetic mapping, Pedigree analysis, lod score for linkage testing. 2. Recombination - Homologus recombination - Holiday junction, site specific recombination - FLP/FRT and Cre lox recombination, Rec A and other recombinases 3. Quantitative genetics: Polygenic inheritance, heritability and its measurements, QTL mapping. 4. Molecular markers in genome analysis, RFLP, RAPD, AFLP, STS, SCAR (Sequence characterized amplified regions), microsatellite, SSCP, QTL.	**15**
UNIT- III	
1. Bacterial genetic system: transformation, conjugation and transduction. Bacterial genetics map with reference to *E.coli*. 2. Complementation analysis, cir-trans test, deletion mapping, Benzer's concept of cistron, concept of overlapping genes.	**15**
UNIT- IV	
1. Southern, Northern and florescence in situ hybridization for genome analysis 2. Chromosome micro-dissection and micro-cloning. 3. Important application of advances in microbial genetics. Production of proteins. 4. Conventional as well as new generation recombinant DNA vaccines, design and advantages	**15**

Suggested Reading

1. Maloy SR, Cronan JE Jr., and Freifelder D, Microbial Genetics, Jones Bartlett Publishers, Sudbury, Massachusetts, 2006.
2. Principles of Genetics by Sinnet et.al,., (McGraw Hill).
3. Principles of Heridity by Robert Tumarin.
4. Genetics by M.W.Strick Berger (Mac Millan).
5. Cell and Molecular Biology by E, D. P. De Roberties (International edition).
6. Microbial Genetics, Malloy, S.R., Cronan, J.E. Jr and Freifelder, D.Jones, Bartlett Publishers

Course Outcomes : **After completing this course, student is expected to learn the following:**

CO1 : Understand the gene mutation, recombination, DNA damage and repair mechanism and their role in livings cells. Learn the identification of various chemical and physical mutagens.

CO2: Learn the concepts of Linkage, Sex Determination, Autosomal and Sex Linked inheritance by Pedigree analysis, Quantitative genetics and Physical and genetic mapping.

CO3: Learn the concepts of bacterial genetics, recombination, complementation analysis and apply it.

CO4: Apply the genetic technique to analyse the diseases and generation of recombinant DNA vaccines by genetic engineering and diverse application in industrial set up.

Course Mapping:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	1	2	2	-	2	-	1	1	3	3	3	3	3	1	1	2	2
CO2	1	2	2	-	2	-	1	1	3	3	3	3	3	1	2	2	2
CO3	1	2	2	-	2	-	1	1	3	3	3	3	3	1	1	2	2
CO4	1	2	2	2	2	-	1	1	3	3	3	3	3	3	3	2	2

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

Skill Development

M. Sc. Biotechnology II semester

Core Course : BT-C205: Practical

[Total Credits : 04; Total Marks= 100; End Semester Exam= 100]

Course objectives: This course enables the students to learn basic practical knowledge of biotechnology lab and principles associated with experimentation.

Topics	Teaching Hrs.
1. To isolate DNA from plant /animal cell/bacterial samples. 2. To isolate RNA from plant /animal/bacterial samples. 3. To prepare 50X TAE buffer for gel electrophoresis. 4. To determine the purity of DNA by using agarose gel electrophoresis. 5. To determine the concentration of DNA and RNA by using UV spectrophotometer. 6. To separate the mixture of amino acid by paper chromatography. 7. To separate the component of mixture of amino acid by thin-layer chromatography (TLC). 8. To study the structure and function of HPLC. 9. To separate proteins by Polyacrlyamide gel electrophoresis (PAGE). 10. To separate subunits of protein by sodium dodecyl sulphate polyacrlyamide gel electrophoresis (SDS-PAGE). 11. To perform FISH for detection the expression of gene. 12. To perform ABO blood group typing by using Haemaggulation Method. 13. To perform cell counting by haemocytometer. 14. To determine blood sugar level in blood sample. 15. To detect the Ag-Abs interaction by double immune diffusion method. 16. To prepare single cell suspension cell culture from spleen. 17. To isolate peripheral blood mononuclear cells from blood sample. 18. To perform Ames test for detection of mutagenic potency of compound. 19. To perform restriction fragment length polymorphism (RFLP). 20. To performed Southern blot for the identification of copy numbers of gene. 21. To detect genetic disorder related to Sex-linked by using pedigree analysis in a given problem.	

Suggested reading

1. Biotechnology Department Practical Manual
2. Wilson Walker Practical Biochemistry
3. Laboratory Manual for Biotechnology by Ashish Verma et al, S chand Publication

Course Outcomes : After completing this course, student is expected to learn the following:

CO1: To impart hands-on training in DNA, RNA, protein isolation and estimation methods.

CO2: To impart practical knowledge on understand pattern of Sex- linked disorders in human population**.**

CO3: Understand the procedure of separating compounds by using chromatography

CO4: To develop skills for identification genes and potency of mutagenic chemicals.

Course Mapping:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	3	3	3	3	1	3	-	-	2	1	3	2	3	3	2	2	2
CO2	3	3	3	3	1	3	-	-	2	1	3	2	3	3	2	2	2
CO3	3	3	3	1	1	3	-	-	2	1	3	2	3	3	2	2	2
CO4	3	3	3	3	1	3	1	1	2	1	3	2	3	3	2	2	2

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

Employability and Skill Development

M. Sc. Biotechnology III semester,

Core Course : BT-C301: Animal Cell Science and Technology

[Total Credits : 04; Total Marks= 100; CIE= 25; End Semester Exam= 75]

Course Objectives: The objective of this course is to provide a Theoretical knowledge of various topics as per the syllabus including basic cell culture techniques; Primary culture, secondary culture; Transfection, pleuripotency, stem cells etc application of animal biotechnology in tissue engineering and vaccines.

Topics	Teaching Hrs.
Unit I	
1. Structure and organization of animal cell. 2. Equipment and materials for animal cell culture technology. 3. Primary and established cell line culture. 4. Introduction to the balanced salt solutions and simple growth medium. Brief discussion on the chemical, physical and metabolic functions of different constituents of culture medium. Role of carbon-dioxide; Role of serum and supplements. 5. Serum and protein free defined media and their application.	**15**
Unit II	
1. Measurement of viability and cytotoxicity. 2. Biology and characterization of culture cells. Measuring parameters of growth 3. Basic techniques of mammalian cell culture in vitro; disaggregation of tissue andprimaryculture; cell separation. 4. Scaling-up of animal cell culture.	**15**
Unit III	
1. Cell synchronization. 2. Cell cloning and micromanipulation. 3. Cell transformation. 4. Application of animal cell culture. 5. Stem cell culture, embryonic stem cells and their applications. 6. Cell culture based vaccines.	**15**
Unit IV	
1. Somatic cell genetics. 2. Organ and histotypic culture. 3. Measurement of cell death. 4. Three dimensional culture and tissue engineering. 5. Animal Cloning – methodology, its application and limitations.	**15**

Suggested Reading

1. Animal cell culture – A practical approach Ed. By John R.W. Masters (IRL Press).
2. Animal cell culture techniques, Ed. Martin clyenes (Springer).
3. Comprehensive Biotechnology. Vol. 4. M. Moo-Young (Ed-in-chief), Pergamon Press, Oxford.
4. Elements of Biotechnology by PK Gupta (Rastogi& Co).
5. Biotechnology by Kashav. T (Wiley Eastern Ltd).
6.Concepts in Biotechnology by Balasubrahmanianet. al.,(University press).
7.Principles and practices of aquaculture by TVR Pillay.
8.Coastal aquaculture by Santhanam.
9.Animal cell culture by Ian Freshney.
10.Molecular Biotechnology by Glick.

Course Outcomes : **After completing this course, student is expected to learn the following:**

CO1. Familiarize with the reagents, equipments, cell culture media, cell line culture and other relevant material to animal cell culture technology.

CO2. Apply the knowledge of viability and cytotoxicity of the cultured cells and scaling up.

CO3. Explore the biomedical research involving tissue engineering that aims to grow and replace tissue in-vitro using stem cell technology. Learn vectorless and vector mediated gene transfer methods for animal cell cloning, cell synchronization and transformation. Study of various approaches related to vaccine production, disease diagnostic assays and many other assays involved in animal health management.

CO4. Able to measure the cell death, organ and histotypic culture and animal cloning by using genetic engineering techniques to improve animals for human welfare.

Course Mapping:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	3	2	2	2	2	2	3	-	-	2	2	-	-	-	3	1	-
CO2	3	2	2	2	2	2	3	1	-	2	2	3	2	2	3	1	2
CO3	3	2	2	2	2	2	3	2	-	2	2	3	2	2	3	1	2
CO4	3	2	2	3	3	3	3	3	3	2	2	3	2	3	3	1	2

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

Employability and Skill Development

M. Sc. Biotechnology III semester,

Core Course : BT-C302 :Genetic Engineering

[Total Credits : 04; Total Marks= 100; CIE= 25; End Semester Exam= 75]

Course Objectives: The student will understand various approaches to conducting genetic engineering and their applications in biological research as well as in biotechnology industries which is reflected in the contents of this course. The student will able to demonstrate the innovative utilization of manipulating enzymes, various cloning and expression vectors. Student will able to interpret the applications of genetic engineering in biotechnological research and strategic uses of recombinant DNA techniques, PCR techniques, methods for protein-DNA interactions, gene silencing and genome editing technologies.

Topics	Teaching Hrs.
Unit I	
1. Scope of Genetic Engineering. 2. Isolation of enzymes, in-vitro synthesis of DNA and patenting of life forms. 3. Restriction enzymes and modification enzymes. 4. Nucleic acid Purification and Yield Analysis. 5. Nucleic Acid Amplification, PCR and Its application	**15**
Unit II	
1. Gene cloning Vectors Plasmids, bacteriophage, phagemides, cosmids, Artificial Chromosomes. 2. Restriction mapping of DNA fragments and Map construction. 3. cDNA Synthesis - mRNA enrichment, reverse transcription, DNA primers, linkers, Adapters and their chemical synthesis, Library construction and screening. 4. Alternative strategies of Gene Cloning. Cloning interacting genes- Two and three hybrid systems. 5. Nucleic acid microarrays.	**15**
Unit III	
1. Site directed Mutagenesis and Protein Engineering. 2. How to study the Gene Regulation? DNA transfection, Northern blot, Primer extension, SI mapping, Rnase protection assay. 3. Expression Strategies for heterologous genes Expression in bacteria, expression in Yeast, expression in insects and insect cells, expression in mammalian cells. 4. Processing of Recombinant proteins. Purification and stabilization of proteins.	**15**
Unit IV	
1. Phase Display. 2. T-DNA and Transposon Tagging 3. Transgenic and gene Knock out Technologies Targeted gene replacement, chromosome engineering. 4. Gene Therapy. Vector engineering, Strategies of delivery, gene replacement/ augmentation, gene correction, gene editing, regulation and silencing.	**15**

Suggested Reading

1. S.B. Primrose, R.M. Twyman and R.W.Old; Principles of Gene Manipulation. 6th Edition, S.B.University Press, 2001.
2. J. Sambrook and D.W. Russel; Molecular Cloning: A Laboratory Manual, Vols 1-3, CSHL, 2001.
3. Brown TA, Genomes, 3rd ed. Garland Science 2006
4. Selected papers from scientific journals.
5. Technical Literature from Stratagene, Promega, Novagen, New England Biolab etc.
6. Genetic Engineering by Sandhya Mitra
7. Gene Technology by SN Jogdand.

Course Outcomes : **After completing this course, student is expected to learn the following:**

CO1: Recite key aspects of various enzymes in gene manipulation techniques to explore recombinant DNA techniques and in-vitro synthesis of DNA. The student learns to purify and amplify the nucleic acids by high throughput techniques used in genomics and transcriptomics. Capable to recognize importance of protection of new knowledge and innovations and its role in business.

CO2: Construct plasmid vectors and illustrate them to comprehend more about its structure and functions. The students recall the principles of genetic engineering and the vectors used in cloning, methods of introduction of gene and expression. The students appreciate the different cloning strategies and their expression. Construction and screening of genomic and c DNA libraries. Get an insight into the concept of different vectors (plasmids, cosmids, phagemids, and artificial chromosome vectors) that act as carrier of DNA fragment between cellular organisms during genetic modification.

CO3: Demonstrate the ability of designing recombinant molecules and conducting experiments involving genetic manipulation and purification. Assess methods of transformation and analyses cloned genes for their markers

Understand the different expression strategies for heterologous genes and their processing.

CO4: Employ various gene editing, engineering, tagging and replacement techniques for gene therapy using different vectors and recombinant products.

Course Mapping:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

Employability, Entrepreneurship and Skill Development

M. Sc. Biotechnology III semester

Core Course : BT-C303: Bioprocess Engineering and Technology

[Total Credits : 04; Total Marks= 100; CIE= 25; End Semester Exam= 75]

Course Objectives: The student will learn the concepts of screening, optimization and maintenance of cultures and to introduce the students to the various concepts of microbial growth kinetics, fermentation and bioprocess engineering. Course will enable the students to learn basics principles of fermentation techniques, design of fermentors and techniques involved in Upstream and downstream bioprocessing.

Topics	Teaching Hrs.
Unit I	
1. Introduction to bioprocess Engineering. 2. Bioreactor and fermentor 3. Isolation, Preservation and Maintenance of Industrial Microorganism. 4. Kinetic of Microbial Growth and death.	**15**
Unit II	
1. Media for industrial fermentation. 2. Air and media sterilization. 3. Type of fermentation process; Analysis of batch, fed batch and continuous bioreactors, stability of microbial reactors, specialized bioreactors (pulsed fluidized photo bioreactors etc).	**15**
Unit III	
1. Measurement and control of bioprocess parameters. 2. Downstream Processing: Introduction, Removal of microbial cell and solid matter, foam precipitation, filtration, centrifugation, cell disruption, liquid-liquid extraction, chromatography, membrane process Drying and crystallization effluent treatment; D.O.C. and C.O.D. treatment and disposal of effluents. 3. Whole cell immobilization and their industrial applications	**15**
Unit IV	
1. Industrial production of chemical; Alcohol (ethanol), Acids (citric acetic,gluconic) solvents (glycerol, acetone), Antibiotics (penicillin, tetracycline) Amino acids (lysine, glutamic acid) ,Single cell protein. 2. Use of microbes in mineral beneficiation and oil recovery. 3. Introduction to food technology: -Elementary idea of canning and packing. -Sterilization and pasteurization of food products. -Food preservation.	**15**

Suggested Reading

1. Jackson AT., Bioprocess Engineering in Biotechnology, Prentice Hall, Engelwood Cliffs, 1991.
2. Shuler ML and Kargi F., Bioprocess Engineering: Basic concepts, 2nd Edition, Prentice Hall, Engelwood Cliffs, 2002.
3. Stanbury RF and Whitaker A., Principles of Fermentation Technology, Pergamon press, Oxford, 1997.
4. Baily JE and Ollis DF., Biochemical Engineering fundamentals, 2nd Edition, McGraw-Hill Book Co., New York, 1986.
5. Aiba S, Humphrey AE and Millis NF, Biochemical Engineering, 2nd Edition, University of Tokyo press, Tokyo, 1973.
6. Comprehensive Biotechnology: The Principles, Applications and Regulations of Biotechnology in Industry, Agriculture and Medicine, Vol 1, 2, 3 and 4. Young M.M., Reed Elsevier India Private Ltd, India, 2004.

7. Mansi EMTEL, Bryle CFA. Fermentation Microbiology and Biotechnology, 2nd Edition, Taylor & Francis Ltd,UK, 2007.

Course Outcomes : **After completing this course, student is expected to learn the following:**

CO1: Understand the structure, operation and functions of various bioreactors and fermentors apply the knowledge of isolation and preservation, maintainance of microorganism in industry.

CO2: Able to prepare media and sterilization. Able to apply the kinetics in fermentation process.

CO3: Learn the basic techniques related to downstream processing.

CO4: Critical analysis of the role of microorganisms for the production and preservation of biotechnological products in different industries.

Course Mapping:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	3	3	3	-	2	3	2	-	2	2	3	2	3	3	1	1	-
CO2	3	3	3	-	2	3	2	2	2	2	3	2	3	3	2	1	3
CO3	3	3	3	-	2	3	2	2	2	2	3	3	3	3	2	1	3
CO4	3	3	3	-	2	3	2	2	2	2	3	3	3	3	2	1	3

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

Employability and Entrepreneurship

M. Sc. Biotechnology III semester

Elective Course : BT-E304: Basic Bioinformatics

[Total Credits : 04; Total Marks= 100; CIE= 25; End Semester Exam= 75]

Course Objectives: The major objective of this course is to provide knowledge of bioinformatics tools as well as use of bioinformatics in biological studies.

Topics	Teaching Hrs.
Unit I	
1. Introduction to Bioinformatics - an overview, introduction and scope of bioinformatics. 2. Use of bioinformatics in nucleic acid sequence database, brief knowledge of sequence alignment and its significance 3. Introduction of Biological databases – Primary sequence database (Protein and DNA), Secondary database, composite database. 4. Applications of bioinformatics - Clinical informatics - Cheminformatic resources and pharmacoinformatics	**15**
Unit II	
1. Searching database and locating genes, Alignment of gene sequences, Local and Global. - Nucleic acid sequence databases: GenBank, EMBL - Protein sequence databases: SWISS-PROT, TrEMBL, PIR - Genome Databases at NCBI, EBI - Derived Databases: basic concept of derived databases, PROSITE, Pfam, - Repositories for high throughput genomic sequences: EST, STS 2. Gene structure prediction: CENSOR, RepeatMasker; detection of functional sites in DNA sequences-PromoterScan and GenScan. 3. Biodiversity and ecosystem based databases	**15**
Unit III	
1. Analysis of DNA sequence: Sequence Similarity, Homology and Alignment; BLAST, FASTA, Multiple sequence alignment (ClustalW, Psi BLAST). Statistical significance of alignments score, motifs and pattern analysis. 2. Designing primers of specific gene. 3. Generation of restriction maps, Generating Phylogenetic trees based on DNA sequence and evolutionary relationship. Phylogenetic trees (PHYLIP) 4. Phylogenetic Inference Package, Sites and Centres	**15**
Unit IV	
1. Protein sequence, structures and interacting proteins databases 2. Predicting ORFs, location of transcription start point and end point, getting polypeptide sequence from a nucleotide sequence. 3. Analysis of proteins: Protein classification, homology modeling, 4. Protein Structure Visualization: tools for structure prediction, validation and visualization;Pymol, Protein Data Bank (PDB) and PDB format.	**15**

Suggested Reading

1. N. C. Jones, P. A. Pevzner, An Introduction to Bioinformatics Algorithms, MPI Press 2004.
2. D. W. Mont, Bioinformatics: Sequence and Genome Analysis, CSHL Press.
3. D. Gusfield, Algorithms on Strings, Trees, and Sequences: Computer Science and ComputationalBiology, Cambridge University Press, 1997.
4. Barnes & Gray: Bioinformatics for geneticists (2003, Wiley)
5. Lesk: Bioinformatics (2nd ed 2006, Oxford)
6. Westhead et al: Bioinformatics Instant Notes (Indian ed 2003, Viva Books)
7. Mount, Bioinformatics (2nd ed 2006, CBS)

8. Hunt and Livesey: Functional Genomics (2006, Oxford)
9. Campbel: Discovering Genomics, Proteomics and Bioinformatics (2006, LPE)
10. Bioinformatics: A practical guide to the analysis of genes and proteins. Baxevanis A.D and Ovellette B.F.F., Wiley-Interscience, (2002).

Course Outcomes : **After completing this course, student is expected to learn the following:**

CO1: Understand the role of computer science in predicting structure and function of biomolecules. Ability to apply existing softwares and online tools effectively to extract information from large databases and to use this information in computer based modeling.

CO2: Know about variety of databases information available for alignment various aspects of macromolecules structure and function. Role of bioinformatics tools in gene analysis.

CO3: Understand the similarities and differences among living organisms on the basis of genetic information

CO 4 Interpret correctly the outputs from tools used to analyze biological data and make meaningful predictions from these outputs

Course Mapping:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	3	3	3	3	3	3	1	-	2	2	3	2	2	3	2	1	3
CO2	3	3	3	3	3	3	1	-	2	2	3	2	2	3	2	1	3
CO3	3	3	3	3	3	3	1	-	2	2	3	2	2	3	2	1	3
CO4	3	3	3	3	3	3	-	-	2	2	3	2	2	3	2	1	3

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

Employability

M. Sc. Biotechnology III semester

Elective Course : BT-E305: Basic Genomics and Proteomics

[Total Credits : 04; Total Marks= 100; CIE= 25; End Semester Exam= 75]

Course Objectives : This course enables students to learn basic of genomics, transcriptomics and microarray, applications of genomics, proteomics, types of proteomics, techniques in proteomics, applications of proteomics.

Topics	Teaching Hrs.
Unit I	
Genome 1. Brief overview of prokaryotic and eukaryotic genome organization; 2. Extra-chromosomal DNA: bacterial plasmids, mitochondria and chloroplast. 3. Human Genome Project	**15**
Unit II	
Genome Mapping : 1. Genetic and physical maps; 2. Markers for genetic mapping; 3. Methods and techniques used for gene mapping, physical mapping, 4. Linkage analysis, cytogenetic techniques, FISH technique in gene mapping, Somatic cell hybridization, in situ hybridization, comparative gene mapping. **Comparative Genomics** : 5. Identification and classification of organisms using molecular markers- 16S rRNA typing/sequencing, SNPs; 6. Use of genomes to understand evolution of eukaryotes, track emerging diseases and design new drugs; 7. Determining gene location in genome sequence	**20**
Unit III	
1. **Proteome and Proteomics**: - Aims, strategies and challenges in proteomics; - Proteomics technologies: 2D-PAGE, isoelectric focusing, mass spectrometry, MALDI-TOF, yeast 2-hybrid system, proteome databases.	**10**
Unit IV	
Functional Genomics and Proteomics : 1. Transcriptome analysis for identification and functional annotation of gene, Contig assembly, chromosome walking and characterization of chromosomes, mining functional genes in genome, 2. Gene function- forward and reverse genetics, gene ethics; 3. Protein-protein and protein-DNA interactions; 4. Protein chips and functional proteomics; 5. Clinical and biomedical applications of proteomics; 6. Introduction to metabolomics, lipidomics, metagenomics and systems biology.	**15**

Suggested Readings

1. Concepts and Techniques in Genomics and Proteomics by N Saraswathy, P Ramalingam Elsevier.
2. Genomics and Proteomics: Principles, Technologies, and Applications. byDevarajanThangadurai (Editor), JeyabalanSangeetha (Editor). Apple Academic Press; 1st edition (2015)
3. Principles of Gene Manipulation and Genomics by Sandy Primrose and Richard Twyman Blackwell Publishers Edition 7 (2006)

4. Recombinant DNA : Genes and Genomics : Short Course, By JD Watson, Publisher W.H. Edition 3 (2607)
5. Chapter 8 Basics of proteomics by Saurabh Bhatia In : Introduction to Pharmaceutical Biotechnology, Volume 2 Enzymes, proteins and bioinformatics IOP Publishing Ltd (2018)
6. S. Sahai - Genomics and Proteomics, Functional and Computational Aspects, Plenum Publication, 1999.
7. Pennington & Dunn - Proteomics from Protein Sequence to Function, 1 st edition, Academic Press, San Diego, 1996.
8. Introduction to proteomics: Tools for new biology by Daniel C. Liebler, Humana Press.

Course Outcomes : **After completing this course, student is expected to learn the following:**

CO1 Understand the molecular characterization of human genome and human genome project.

CO2 Recognize and interpret the techniques involved in genomics and proteomics. Administer the principles to discover novel drug.

CO3 Learn the techniques involved in structural and functional proteomics

CO4 Apply protein- protein and protein-DNA interaction to make protein / DNA chips for clinical and medical diagnostics.

Course Mapping:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	3	3	3	3	-	1	-	-	2	-	3	2	2	3	1	1	-
CO2	3	3	3	3	-	1	-	-	2	-	3	2	2	3	1	1	2
CO3	3	3	3	3	-	1	-	-	2	-	3	2	2	3	1	1	2
CO4	3	3	3	3	-	1	-	1	2	-	3	2	2	3	1	1	1

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

Skill Development

M. Sc. Biotechnology III semester

Core Course : BT-C306: Practical

[Total Credits : 04; Total Marks= 100; End Semester Exam= 100]

Course objectives: This course enables the students to learn basic practical knowledge of biotechnology lab and principles associated with experimentation.

Topics	Teaching Hrs.
1. To prepare balanced salt solution for animal cell culture. 2. To prepare tissue culture media for animal cell culture. 3. To perform cell viability assay for detection of viable cells. 4. To perform test for detection of cell death in sample. 5. To perform cell-cell fusion by using polyethylene glycol (PEG). 6. To screen transformed bacterial cells by using Blue- white selection method. 7. Digestion of λ DNA by restriction enzyme and their sample analysis using RFLP. 8. To synthesize C-DNA from different RNA samples for analysis of genes expression/amplification. 9. To design primers for testing genomic DNA contamination in C- DNA samples. 10. To design primers for site-directed mutagenesis (SDM) to change in codon sequence. 11. To amplify desire gene sequence by using polymerase chain reaction (PCR). 12. To perform DNA sequencing for amplify gene sequence/clone sequence. 13. To prepare competent cell for transformation a clone/construct. 14. To study bacterial growth kinetics, doubling time and different phases. 15. To prepare media for industrial/fermentation process and its sterilization. 16. To perform different method cell disruption – mechanical and chemical methods. 17. To sterilize laboratory fermentor and other instrument. 18. To perform ethanol production in laboratory at small scale. 19. To check DO, BOD, salt and ammonia in a given water sample. 20. To retrieve genomic and protein sequences from NCBI databases. 21. To compare different protein sequences for homology analysis by using Clustal W alignment. 22. To construct phylogenic tree by using different protein sequences for analysis of evolutionary study.	

Suggested reading

1. Biotechnology Department Practical Manual
2. Wilson Walker Practical Biochemistry
3. Laboratory Manual for Biotechnology by Ashish Verma et al, S chand Publication

Course Outcomes : After completing this course, student is expected to learn the following:

CO1: To impart knowledge on handling and the culture of animal cell culture media and animal cell line.

CO2: To develop knowledge for analysis expression of a gene and to introduce mutation.

CO 3: To identify and analyze the environmental waste water sample

CO4: To learn the bioinformatics tools for solving the molecular biological problems

Course Mapping:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	3	3	3	3	3	3	-	-	2	2	3	3	3	3	3	2	2
CO2	3	3	3	3	3	3	2	-	2	2	3	3	3	3	3	2	2
CO3	3	3	3	3	3	3	3	-	2	2	3	3	3	3	3	2	2
CO4	3	3	3	3	3	3	2	-	2	2	3	3	3	3	3	2	2

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

Employability, Entrepreneurship and Skill Development

M. Sc. Biotechnology IV semester

Core Course : BT-C401:Plant Biotechnology

[Total Credits : 04; Total Marks= 100; CIE= 25; End Semester Exam= 75]

Course Objectives : In this course students will learn the basic concepts and principles of in vitro propagation methods, cryopreservation, genetic transformation methods, genetic manipulation, marker assisted plant breeding and QTL mapping. To provide knowledge on genetic engineering in the improvement of plants for human welfare.

Topics	Teaching Hrs
Unit I	
1. Introduction to cell and tissue culture, tissue culture as a technique to produce novel plants and hybrids. 2. Tissue culture media (composition and preparation). 3. Initiation and maintenance of callus and suspension culture, single cell clones. 4. Organogenesis, somatic embryogenesis; transfer and establishment of whole plant in soil.	**15**
Unit II	
1. Shoot tip culture, rapid clonal propagation and production of virus free plants. 2. Embryo culture and embryo rescue. 3. Protoplast isolation, culture and fusion, selection of hybrid cells and regeneration of hybrid plants; symmetric or asymmetric hybrids cybrids. 4. Anther, pollen and ovary culture for production of haploid plants and homozygous lines . 5. Cryopreservation, slow growth and DNA banking for germplasm conservation.	**15**
Unit III	
1. Plant Transformation technology – basis of tumor formation, hairy root, feature of Ti and Ri plasmids, mechanism of DNA transfer, role of virulence genes. 2. Use of Ti and Ri as vectors - binary vectors and co integrate vector. 3. Genetic markers – reporter gene, selectable marker genes. 4. Transgenic stability – use of 30S promoter, reporter gene with introns, use of scaffold attachment regions. 5. Methods of nuclear transformation - viral vectors and their applications, vector less or direct DNA transfer. 6. Chloroplast transformation.	**15**
Unit IV	
1. Application of plant transformation for productivity and performance Herbicide resistance -phosphoinothricin, glyphosate, sulfonyl urea, atrazine. Insect resistance - bt genes Non bt like protease inhibitors. Alpha amylase inhibitor. Virus resistance - coat protein mediated, nucleocapsid gene. Disease resistance - chitinase, 1-3 beta glucanase, RIP, antifungal proteins thionins, PR proteins. Nematode resistance. Abiotic stress post-harvest losses - long a shelf life of fruits and flowers, uses of ACC synthase, polygalacturonase, ACCoxidase. Male-sterile lines - bar and barnase system. Carbohydrate composition and storage - ADP glucose pyrophosphorylase. 2. Plant secondary metabolites - control mechanisms and manipulation of phenylpropanoid pathway, shikimate pathway, alkaloids, industrial enzymes, biodegradable plastic –polyhyroxybutyrate, Therapeutic proteins, lysosomal enzyme antibodies, edible vaccines, 3. Green House.	**15**

Suggested Reading

1. Introduction to Plant Biotechnology, H S Chawala 2009, 3rd Edition, Science Publishers
2. Agricultural Biotechnology, 1st edition, (2008) Rawat H, Oxford Book Co, India.
3. Agrobiotechnology and plant tissue culture, Bhojwani SS, Soh WY, Oxford & IBH Publ, India
4. Agricultural Biotechnology, (2005), Kumar HD, DayaPubl House, India
5.Plant tissue culture and molecular markers: Their role in improving crop productivity Ashwani Kumar, Shekhawat NS (2009) (IK International)
6. Plant Biotechnology by A. Slater, N.W. Scott and M.R. Fowler (Oxford University press).
7. Biotechnology in Agriculture by Swaminathan, M.S (Mc. Milllan India Ltd).
8. Biotechnology and its applications to Agriculture, by Copping LG and P.Rodgers (British Crop Projection).
9. Plant Biotechnology, by Kung, S.andC.J.Arntzen (Butterworths).
10. Biotechnology By U Satyanarayana.

Course Outcomes : **After completing this course, student is expected to learn the following:**

CO1: Establish different types of plant cultures.

CO2: Develop skill in raising transgenics resistant to biotic & abiotic stresses & quality characteristics and their role in crop improvement

CO3: Apply the practical skills for entrepreneurial development.

CO4: Design and implement experimental procedures using relevant techniques. Apply the concepts of Biotechnology in Environmental Management.

Course Mapping:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	3	1	1	1	3	3	3	-	2	2	3	3	3	3	3	1	2
CO2	3	1	2	3	3	3	3	-	2	2	3	3	3	3	3	1	2
CO3	3	3	3	2	3	3	3	-	2	2	3	3	3	3	3	1	2
CO4	3	3	3	3	3	3	3	-	2	2	3	3	3	3	3	1	2

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

Employability and Entrepreneurship

M. Sc. Biotechnology IV semester

Core Course : BT-C402:Environmental Biotechnology

[Total Credits : 04; Total Marks= 100; CIE= 25; End Semester Exam= 75]

Course Objectives: This course will orient students to various aspects of environment and life forms that includes energy and environment, pollution and environment, waste management, bioremediation removing pollutants from environments, environment monitoring and informatics.

Topics	Teaching Hrs.
Unit I	
1. Environment: basic concepts and issues. 2. Environmental pollution: types of pollution, Methods for the measurement of pollution, Methodology of environment management the problem solving approach, its limitation. 3. Air pollution and its control through biotechnology.	**15**
Unit II	
1. Need for water managements, Measurement and water pollution, sources of water pollution, Waste water collection 2. Waste water treatment – physical and chemical processes. 3. Microbiology of Waste water Treatment, Aerobic Process: Activated sludge, Oxidation ditches, trickling, towers, rotation dises, rotating drums, oxidation ponds. 4. Anaerobic Processes: Anaerobic digestion, anaerobic filters, Upflow anaerobic blanket reactors.	**15**
Unit III	
1. Treatment schemes of wastewater of dairy, distillery, tannery, sugar, antibiotic industries. 2. Solid wastes: Sources and managements (composting, worm culture and methane production) 3. Microbiology of degradation of Xenobiotic in Environment- degradative plasmids; hydrocarbons. Substituted hydrocarbons, oil pollution and pesticides.	**15**
Unit IV	
1. Bioremediation of contaminated soil and wasteland. 2. Bio pesticides and integrated pest management. 3. Global Environment Problems: Ozone depletion, UV-B, greenhouse effect and acid rain, their impact and biotechnological approaches for management. 4. Environmental Monitoring – environmental impacts and their assessments using bio-indicators, biomarkers and biosensors.	**15**

Suggested Reading

1. Biotechnology by B.D.Singh (Kalyani).
2. Ecology and Environment by PD Sharma.
3. Fundamentals of Ecology, by Odum, EP (McGraw Hill)
4. Environmental Biotechnology by Forster, C.F. and Wase D.A.J. (Ellis Horwood).
5. Biotechnological innovations in environmental management by Leach, CK and Van DamMieras, MCE (Butterworth-Herinemann, Oxford (Biotol Series).
6. Molecular Biology and Biotechnology by Meyers, RA, A comprehensive Desk reference (VCH Publishers).
7. Biotechnology by U. Satyanarayana (Books & Allied (P) Ltd).
8. Environmental Biotechnology by JN Jogdand.
9. Principles and Applications of Environmental Biotechnology for a Sustainable Future,by Ram Lakhan Singh. Springer Singapore.

Course Outcomes : **After completing this course, student is expected to learn the following:**

CO1: Learn the source, issue and mechanism of environmental pollution.

CO2: Apply the microbes and plants in remediation and management of environmental pollution.

CO3: Understand the replacement/options available for non-degradable pollutants. Concept building in alternate energy sources: Biomass as source of energy; Biocomposting; Biofertilizers; Vermiculture; Organic farming; Bio-mineralization; Biofuel etc.

CO4: Apply the knowledge in Environmental monitoring and solve the global environment problems through biotechnology.

Course Mapping:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	2	3	3	-	3	-	3	-	2	2	3	3	3	3	3	1	-
CO2	2	3	3	-	3	-	3	-	2	2	3	3	3	3	3	1	-
CO3	2	3	3	-	3	3	3	1	2	2	3	3	3	3	3	1	2
CO4	2	3	3	1	3	3	3	-	2	2	3	3	3	3	3	1	2

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

Employability and Skill Development

M. Sc. Biotechnology IV semester

Elective Course : BT-E403: Molecular Diagnostics

[Total Credits : 04; Total Marks= 100; CIE= 25; End Semester Exam= 75]

Course Objectives: After completing the course student will able to use critical thinking skills to trouble shoot problems as they occur and determine possible causes. Identify the important parameters in the design of a laboratory to conduct the most commonly-used molecular diagnostics protocols. Perform quality control (QC) procedures according to established protocol and evaluate the results.

Topics	Teaching Hrs.
Unit I	
1. **Genome biology in health and disease:** An overview; - Chromosomal structure & mutations; - DNA polymorphism: human identity; - Clinical variability and genetically determined adverse reactions to drugs. **2. Genome: resolution, detection & analysis:** - PCR: Real-time; ARMS; Multiplex; ISH; FISH; RFLP; SSCP; - Nucleic acid sequencing: new generations of automated sequencers; - Microarray chips; Microarray data normalization & analysis; 3. 4. **Diagnostic proteomics:** SELDI-TOF-MS; Bioinformatics data acquisition & analysis.	**15**
Unit II	
1. **Diagnostic metabolomics:** Metabolite profile for biomarker detection the body fluids/tissues in various metabolic disorders by making using LCMS & NMR technological platforms. 2. **Detection and identity of microbial diseases:** Direct detection and identification of pathogenic-organisms that are slow growing or currently lacking a system of in vitro cultivation as well as genotypic markers of microbial resistance to specific antibiotics.	**15**
Unit III	
1. **Detection of inherited diseases:** Exemplified by two inherited diseases for which molecular diagnosis has provided a dramatic improvement of quality of medical care: - Fragile X Syndrome: Paradigm of new mutational mechanism of unstable triplet repeats, - von-Hippel Lindau disease: recent acquisition in growing number of familial cancer syndromes.	**15**
Unit IV	
1. **Molecular oncology:** - Detection of recognized genetic aberrations in clinical samples from cancer patients; - Types of cancer-causing alterations revealed by next-generation sequencing of clinical isolates; - Predictive biomarkers for personalized onco-therapy of human diseases such as chronic myeloid leukemia, colon, breast, lung cancer and melanoma as well as matching targeted therapies with patients and preventing toxicity of standard systemic therapies. 2. **Quality assurance and control:** Quality oversight; regulations and approved testing.	**15**

Suggested Reading:

1. Campbell, A. M., &Heyer, L. J. (2006). Discovering Genomics, Proteomics,and Bioinformatics. San Francisco: Benjamin Cummings.
2. Brooker, R. J. (2009). Genetics: Analysis & Principles. New York, NY: McGraw-Hill.

3. Glick, B. R., Pasternak, J. J., & Patten, C. L. (2010). *Molecular Biotechnology: Principles and Applications of Recombinant DNA*. Washington, DC: ASM Press.
4. Coleman, W. B., &Tsongalis, G. J. (2010). *Molecular Diagnostics: for the Clinical Laboratorian*. Totowa, NJ: Humana Press.

Course Outcomes : **After completing this course, student is expected to learn the following:**

CO1: Understand the various molecular techniques used in diagnostics. Identify the important parameters in the design of a molecular diagnostic test.

CO2: Apply the knowledge to detect and identify the diseases

CO3 : Learn to detect the inheritable diseases

CO4: Learn to detect the various types of cancers causing alteration by next generation sequencing and use biomarkers for oncotherapy

Course Mapping:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	3	3	3	3	2	2	-	-	1	-	3	3	3	3	2	1	2
CO2	3	3	3	3	2	2	-	-	1	-	3	3	3	3	2	1	2
CO3	3	3	3	3	2	2	-	-	1	-	3	3	3	3	2	1	2
CO4	3	3	3	3	2	2	-	-	1	-	3	3	3	3	2	1	2

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

Employability

M. Sc. Biotechnology IV semester

Elective Course : BT-E404: Stem Cell Biology

[Total Credits : 04; Total Marks= 100; CIE= 25; End Semester Exam= 75]

Course Objective: To explore the biomedical research involving tissue engineering that aims to grow and replace tissue *in-vitro* using stem cell technology.

Topics	Teaching Hrs.
Unit I	
1. Introduction to Stem Cells, 2. Definition, Classification and Sources.	**15**
Unit II	
1. Embryonic Stem Cells 2. Blastocyst and inner cell mass cells, Organogenesis, 3. Mammalian Nuclear Transfer Technology, 4. Stem cell differentiation, stem cells cryopreservation.	**15**
Unit III	
1. Application of stem Cells 2. Overview of embryonic and adult stem cells for therapy Neurodegenerative diseases; Parkinson's, Alzheimer, 3. Tissue system Failures: Diabetes, Cardiomyopathy, Kidney failure, Liver failure, Hemophilia.	**15**
Unit IV	
1. Human Embryonic Stem Cells and Society 2.Human stem cells research: Ethical consideration; Stem cell religion consideration; 3. Stem cell based therapies: Pre clinical regulatory consideration and Patient advocacy.	**15**

Suggested Reading

1. Ann A. Kiessling, Human Embryonic Stem Cells: An Introduction to the Science and Therapeutic Potential, Jones and Bartett, 2003.
2. Peter J. Quesenberry, Stem Cell Biology and Gene Therapy, 1st Edition, Willy-Less, 1998.
3. Robert Lanja, Essential of Stem Cell Biology, 2nd Edition, academic Press, 2006.
4. A.D.Ho., R.Hoffiman, Stem cell Transplantation Biology Processes Therapy, Willy-VCH, 2006.
5. C. S. Potten, Stem Cells, Elsevier, 2006.
6. Essentials of Stem Cell Biology, 2nd edition, (2009) Robert Lanza, et al. Elsevier Academic Press, USA
7. Stem cells and the future of regenerative medicine, 1st edition, (2002), National research council and Institute of medicine, National Academic press, Washington DC
8. Molecular Biotechnology: 4th edition. (2010), Glick B.R., Pasternak J.J., Patten C. L., ASM press, USA

Course Outcomes : **After completing this course, student is expected to learn the following:**

CO1: Understand the stem cell classification and sources.

CO2: Learn the nuclear transfer technology stem cell differentiation and cryopreservation.

CO3: Apply stem cell therapy for neurodegenerative diseases and tissue system failure.

CO4: Lean the ethical and religion consideration of stem cell based therapy.

Course Mapping:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	3	3	-	-	2	-	-	-	-	-	3	3	1	-	3	1	2
CO2	3	3	2	-	2	-	-	-	-	-	3	3	1	-	2	1	2
CO3	3	3	2	1	2	-	-	1	1	-	3	3	1	1	3	1	2
CO4	3	3	-	-	2	-	-	3	1	-	3	3	1	1	3	1	2

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

Employability, Entrepreneurship and Skill Development

M. Sc. Biotechnology IV semester

Elective Course : BT-E405: Food Biotechnology

[Total Credits : 04; Total Marks= 100; CIE= 25; End Semester Exam= 75]

Course Objectives: In this course students will learns various aspects of biotechnology in food industry and processing that includes microbial biotechnology, enzyme in food technology, nanobiotechnology, prebiotics and probiotics, nutraceuticals, QC and QA quality, quality improvement, and food laws.

Topics	Teaching Hrs.
Unit I	
1. Introduction and history of food microbiology, General characteristics, classification and importance of microorganisms important in food microbiology, 2. Principles of food preservation. Asepsis–Removal of microorganisms, (anaerobic conditions, high temperatures, low temperatures, drying, canning, food irradiation). 3. Factors influencing microbial growth in food – Extrinsic and intrinsic factors; 4. Chemical preservatives.	**15**
Unit II	
1. Contamination and spoilage: Cereals, sugar products, vegetables, fruits, meat and meat products, Milk and Milk products, Fish and sea foods, poultry food, spoilage of canned foods. 2. Detection of spoilage and characterization. 3. Food-borne infections and intoxications: Bacterial and nonbacterial toxins with examples of infective and toxic types – *Brucella*, *Bacillus*, *Clostridium*, *Escherichia*, *Salmonella*, *Shigella*, *Staphylococcus*, *Vibrio*, *Yersinia*, *Nematodes*, *protozoa*, *algae*, *fungi* and *viruses*.	**15**
Unit III	
1. Food fermentations: Industrial production method for microbial starters, bread, cheese, vinegar, fermented vegetables, fermented dairy products; 2. Fermented beverages: beer and wine. 3. Microbial cells as food (single cell proteins, mushrooms), 4. Amino acid production: glutamic acid and lysine. 5. Production of probiotics and prebiotics, nutraceuticals, low calorie sweetener, food coloring and naturally occurring flavor modifiers.	**15**
Unit IV	
1. Food quality standards, Monitoring and control, 2. Food Adulteration, R&D innovations in food microbiology, 3. Genetically modified foods, 4. Need and requirements of food packaging; Containers for packaging, Dispensing devices, 5. Food Regulations/Safety & Quality Standards & Food Laws	**15**

Suggested readings

1. Food microbiology- Royal society of chemistry: MR Adams and MO Moss.
2. Principles of fermentation technology: PF Stanbury, A Whitekar and SJ Hall, Pergamon Press.
3. Basic Food Microbiology: GJ Banwart, CBS Publishers.

Course Outcomes : **After completing this course, student is expected to learn the following:**

CO1 Ability to acquire knowledge about the food microbiology, food preservation and chemical preservatives.

CO2 Understand the sources of food contamination, able to specify food spoilage – its types, causative agents and changes associated with it; enumerate factors affecting the rate of spoilage.

CO3 Apply the knowledge in fermentation industry for the production of beverages, amino acids, prebiotics, probiotics and dairy products.

CO4 Knowledge building over public acceptance of genetically modified crops and government regulations of GM crops will help them engage in solving social problems and understand social concerns about new technology

Course Mapping:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	3	2	3	1	3	1	2	1	2	2	3	2	3	3	3	1	2
CO2	3	2	3	1	3	1	2	1	2	2	3	3	3	3	3	1	2
CO3	3	3	3	2	3	3	3	1	2	2	3	3	3	3	3	1	3
CO4	3	3	3	3	3	3	3	3	3	2	3	3	3	3	3	1	3

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

Employability, Entrepreneurship and Skill Development

M. Sc. Biotechnology IV semester

Elective Course : BT-E406: Agriculture Biotechnology

[Total Credits : 04; Total Marks= 100; CIE= 25; End Semester Exam= 75]

Course Objectives : This course enables students to learn basic of agricultural biotechnology, crop improvement, development and formulation (with various carrier materials) of bioinoculants, for better agricultural productivity.

Topics	Teaching Hrs.
Unit I	
1. Introduction to Agricultural biotechnology: Concepts and scope of Agricultural Biotechnology 2. Crop improvement hybridization and plant breeding techniques. 3. Micropropagation and plant tissue culture technique and its application in agriculture. 4. Somatic hybridization, haploid production and cryopreservation 5. Study of biopesticides used in agriculture (neem as example)	**15**
Unit II	
1. Mechanism of biological nitrogen fixation process. Study of NIF, NOD and HUP genes nitrogen fixation process. 2. Production of bio-fertilizers and applications of rhizobium, azotobacter, azolla and myconrrhiza 3. Use of plant growth regulators in agriculture and horticulture.	**15**
Unit III	
Biotechnology for quality crop development 1. Technological change in agriculture, Green Revolution: traditional and non-traditional methods of crop improvement. Molecular genetics of Photosynthesis, theory and techiques for the development of transgenic plants-conferting resistance to herbicide (Glyphosate und BASTA) 2. Pesticide (Bt-Gene) Technological change in agriculture- for biotic, abiotic stress: Improvement of crop yield and quality fruit ripening	**15**
Unit IV	
Agro-industrial biotechnology 1. Techniques of some plant tissue culture techniques for bio-resource production: 2. Micropropagation; Somaclonal variation, Artificial seed production; Androgenesis and its applications in genetics and plant breeding: Cell cultures for secondary metabolite production: (Gemplasm conservation and cryopreservation). 3. Agro-industry: Microbes in agriculture, Bio-fertilizer, Microbial enzymes and their applications in agro-chemical industries, Biocatalyst; Agro-waste utilization; Mycorrhiza in agriculture and forestry	**15**

Suggested Reading

1. Plant Biotechnology and Genetics: Principles, Techniques and Applications C. Neal Stewart, J. Editor) Wiley, 2008

2. Agricultural biotechnology by. S. Prot - Second Enlarged ation, Agrobios, 2007

3 Agricultural Biotechnology, HD. Kumar Daya Publishing House, 2005,

4. Agricultural Biotechnology Challenges and Prospects Elite by Mahesh K. Bhalga, William P- Ridley, Allan. Felst, and James N, Seiber.

Course Outcomes : **After completing this course, student is expected to learn the following:**

CO1 Ability to acquire knowledge about the range of approaches to manipulate and improve plants. Develop bio-pesticides based on knowledge acquired.

CO2 Understand the production of bio-fertilizers and use of plant growth regulator in agriculture.

CO3 Apply the knowledge for quality crop development.

CO4 Able to produce the biofertilizers, biocatalysts, artificial seeds, etc.

Course Mapping:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	3	3	3	3	3	2	1	-	3	1	3	3	2	1	3	1	2
CO2	3	3	3	3	3	2	2	-	3	1	3	3	2	3	3	1	2
CO3	3	3	3	3	3	2	1	-	3	1	3	3	2	2	3	1	2
CO4	3	3	3	3	3	2	1	-	3	1	3	3	2	3	3	1	2

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

Skill Development

M. Sc. Biotechnology IV semester

Core Course : BT-C407: Practical

[Total Credits : 04; Total Marks= 100; End Semester Exam= 100]

Course objectives: This course enables the students to learn basic practical knowledge of biotechnology lab and principles associated with experimentation.

Topics	Teaching Hrs.
1. To understand different methods for maintaining aseptic condition in plant tissues culture laboratory. 2. To prepare plant tissue culture medium (MS medium) and its sterilization. 3. To induce of callus from given explants sample. 4. To generate virus free plants from explants through callus induction. 5. To prepare artificial seeds through somatic embryogenesis. 6. To isolate protoplast for generation of hybrid, transformation with Ti/Ri plasmid/ reporter genes. 7. To grow Single cell culture/ cell suspension culture from plant tissues in laboratory. 8. To detect and measure different pollutants in the given soil and water samples. 9. To culture earthworms for solid waste treatment and produce vermin-composite. 10. To perform real time PCR for detection the expression of gene. 11. To grow Stem cells of plants from given single cell/tissues by using plant tissue culture. 12. To preservations of food, milk, vegetables, meat, etc. by using different methods. 13. To produce beverages (ethanol) by using Yeast from molasses/ C - source. 14. To produce single cell protein from different C/N sources. 15. To learn the packaging and storage of different foods and other dairy products. 16. To isolate nitrogen fixation bacteria from root nodules/ rhizospheric soil. 17. To cultivate microbes as bio-fertilizes for agriculture. 18. To test drought/saline resistant in plants- Arabidopsis.	

Suggested reading

1. Biotechnology Department Practical Manual
2. Wilson Walker Practical Biochemistry
3. Laboratory Manual for Biotechnology by Ashish Verma et al, S chand Publication

Course Outcomes : After completing this course, student is expected to learn the following:

CO1: To know the importance of biofertilizers and biopesticides

CO2: To acquire hands-on training for the production of fermented products, organic acid, enzymes

CO 3: To provide practical knowledge and skill in the isolation of organisms from contaminated foods

CO4: To understand the quality of water using BOD and COD and to determine the potability of water sample

Course Mapping:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	3	3	3	2	1	2	3	1	2	1	3	3	3	2	3	1	2
CO2	3	3	3	2	1	2	2	1	2	1	3	3	3	2	3	1	2
CO3	3	3	3	2	1	2	2	1	2	1	3	3	3	2	3	1	2
CO4	3	3	3	2	1	2	3	1	2	1	3	3	3	2	3	1	2

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

Department Of Computer Science

Dr. Bhimrao Ambedkar University,

Agra

Detailed Syllabus

for

B.Sc. (Research)

and

M.Sc. (Computer Science)

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Year wise Structure of
B.Sc. (Research) in Science
and
Master in Science (Computer Science)

Year	Sem.	Course Code	Paper Title	Theory/Practical	Credits
4	VII	B070701T	Compiler Design & Principles	Theory	4
		B070702T	Foundation of Artificial Intelligence	Theory	4
		B070703T	Software Engineering	Theory	4
			Lab	Practical	4
		B070901T	Information and Network Security	Theory	4
			Literature Survey	Research	4
4	VIII	B070801T	Digital Image Processing	Theory	4
		B070802T	Mobile Applications	Theory	4
		B070803T	Quantum Information and Computation	Theory	4
			Lab	Practical	4
		B071001T	Advance Design and Analysis of algorithms	Theory	4
		B070806R	Research Project	Research	4
		B070807T	One Minor Elective from Other Faculty	Theory	4
5	IX	Select any four theory papers			
		B070902T	Artificial Neural Networks	Theory	4
		B070903T	Machine Learning Techniques	Theory	4
		B070905T	Parallel Computing and Algorithms	Theory	4
		B070908T	Software Project Management	Theory	4
		-	Lab	Practical	4
		B070910T	Software Testing and Audit	Theory	4
		B070914T	Foundation on Data Science	Theory	4
		-	Literature Survey	Research	4
5	X	Select any four theory papers			
		B071002T	Quantum Neural network	Theory	4
		B071003T	Deep Learning & Pattern Recognition	Theory	4
		B071004T	Computer Vision	Theory	4
		B071009T	Principal of Software Reliability Engineering	Theory	4
		B071010T	IoT	Theory	4
		B071015T	Big Data & Data Analytics	Theory	4
		-	Lab	Practical	4
		-	Dissertation	Research	4
				Total Credits	100

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Department Of Computer Science

Programme/Class: Bachelor(Research) in Science	Year: Fourth	Semester: VII
Subject: Computers		
Course Code: B070701T	Course Title: Compiler Design & Principles	

Course Outcomes

After the completion of the course, the student will be able to

CO 1-Acquire the basic knowledge of compiler, lexical rules, and grammars for programming language

CO 2- Apply parsing techniques on given expression, based on given grammar

CO 3-Describe and implement different techniques for intermediate code and machine code optimization to improve the program efficiency

CO 4- Describe and implement the use of symbol table, error detection and handling concept during different phases of compiler.

Credits: 4	Core Compulsory
Max. Marks: 25+75	Min. Passing Marks:

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0

Unit	Topics	No. of Lectures
I	**Introduction and Lexical Analysis** Compiler, Translator and its need, the phases of a compiler, Cousins of the Compiler, grouping of Phases, Bootstrapping. Role of lexical analyzer, Input buffering, specification & Recognition of tokens, Regular sets and expression, Finite automata, Conversion of Regular expression to Finite automata, Obtaining Regular expression from Finite Automata, Optimization of Deterministic Finite automata states.	8
II	**Lexical Analysis** Lexical-analyzer generator, LEX-compiler, Formal grammars and their application to syntax analysis, BNF notation, ambiguity, YACC. The syntactic specification of programming languages: Context free grammars, derivation and parse trees.	7
III	**Basics of Parsing** Context Free Grammar, Derivation and Parse Tree, Basic Parsing Techniques: Parsers, Shift reduce parsing, operator precedence parsing, top down parsing, predictive parsers, Back tracking Parser or Recursive-descent parsing, LL parsing, Bottom Up Parsing (Shift - reduce parser, LR, Parser, SLR Parser, LALR Parser).	7

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IV	**Construction of Parser** Automatic Construction of efficient Parsers: LR parsers, the canonical Collection of LR(0) items, constructing SLR parsing tables, constructing Canonical LR parsing tables, Constructing LALR parsing tables, using ambiguous grammars, an automatic parser generator, implementation of LR parsing tables.	8
V	**Syntax-directed Translation** Syntax-directed Translation schemes, & Implementation of Syntax-directed Translators, Intermediate code, postfix notation, Parse trees and syntax trees, L-attribute and S-attribute, three address code, quadruple, triples, Postfix notation, translation of assignment statements, Boolean expressions, statements that alter the flow of control, postfix translation, translation with a top down parser, Array references in arithmetic expressions, procedures call, declarations and case statements, implementation of syntax directed translator.	8
VI	**Symbol Tables** Contents of symbol table, Data structure for symbols tables, representing scope information, Run-Time Administration, implementation of simple stack allocation scheme, storage allocation in block structured language, Storage allocation , Activation Record.	7
VII	**Error Detection & Recovery** Types of errors, Errors at different phases, Lexical Phase errors, syntactic phase errors, semantic errors, Error recovery strategies, Panic mode, Phrase level recovery, Error production, Global production, Error recovery in parsing, Run-time errors.	7
VIII	**Code Optimization and Code Generation** Principles sources of optimization, loop optimization, DAG representation of basic blocks, values numbers and algebraic laws, Global data-flow analysis, Machine-Independent Optimizations, Issues in the design of code generator, a simple code generator, Basic Blocks and Flow Graphs, Optimization of Basic Blocks, register allocation and assignment, code generation from DAG, Code Generator.	8

Suggested Readings:

1. Aho, Sethi & Ullman, "Compilers: Principles, Techniques and Tools", 2nd Edition, Pearson Education, 2007.
2. V Raghvan, " Principles of Compiler Design", Tata McGraw Hill Education, 2010.
3. Kenneth C. Louden," Compiler Construction", PWS Publishing Company (Cengage Learning).

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Programme: Master in Science (Computer Science)	Year: ~~First~~ Fourth	Semester: ~~II~~ VIII
Subject: Computer Science		
Course Code: B070902T	Course Title: Foundation on Artificial Intelligence	

Course outcomes: Upon the completion of the course, the student will be able to understand the basics of AI, its Applications in the real world, how to represent a real world problem (like Water Jug Problem, Travelling Salesman Problem, Tic Tac Toe, Chess Playing etc.) and to get the solution through various search algorithms. The student will learn, how machines answer to certain questions in various fields. Student can also understand about Expert systems that are used widely in various fields.

Credits: 2	Core Compulsory
Max. Marks: 25+75	Min. Passing Marks:

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 2-0-0

Unit	Topics	No. of Lectures
I	Introduction To Artificial Intelligence, Foundations And History Of Artificial Intelligence, Problem Domain Of AI, General Issues In AI , AI Techniques, AI Tasks, Game Playing, Theorem Proving, Robotics, Perception And Speech Recognition, NLP, Expert System, Criteria Of Success, Level Of Modeling, State Space Representation, Problem Description. Applications Of Artificial Intelligence, Intelligent agents	7
II	Problem Representation, Introduction To Search : Searching For Solutions, Production system, control strategies, Problems like water jug, 8-puzzle, travelling salesman and etc., Back tracking algorithm,Breadth First Search, Depth First Search, Iterative Deepings, Problem Characteristic, Commutative Production System, Random search, Bidirectional search, Uniform cost searching, branch and bound searching.	8
III	Heuristic Search Methods, A* Algorithm, Observation on A* algorithm, admissibility of A*, Problem Reduction, And-OR Graphs, Hill Climbing, Constraint Satisfaction, Game Playing, Minmax Search Procedure And Alpha Beta Cutoff, Local beam search, Memory based searching, Simulated annealing.	7
IV	Knowledge Representation Issues In Knowledge Representation Characteristic Of The Knowledge And	8

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	Knowledge Representation Model, Representation Mapping, Issues, Various Kind Of Knowledge Representation Models, First Order Predicate Logic, Its Properties, Representation In Wff Application Of Predicate Logic In A.I, Backward Reasoning Method, Resolution, Rules Of Inference, Modus Pones, Clause Form Representation, Theorem Proving, Control Strategies (BF, Linear Input Form, Set Of Support Etc.), Unification, Questioning And Answering.	
V	Natural deduction, Rule Based Systems, Deficiencies In Clause Form And Resolution, Forward Rule Base Deduction System, Backward Rule Base Deduction System, Representation Of Facts, Rule And Goal Wffs In AND OR Graph Representation, Unify Composition And Answer Extraction. Expert Systems, Components Of Expert Systems, Applications Of Expert System	7
VI	Object - Centred Structure Of Knowledge Representation, Its Advantages, Isa And Instance Representation, Class Inclusion And Membership, Property Inheritance, Semantic Net, Partition Semantic Net, Presentation Of Wffs Of Predicate Logic In Semantic Net, Frame Structure, Regular Class And Meta Classes, Property Inheritance Algorithm, Scripts, conceptual dependency.	8
VII	Handling Uncertainty , Basic probability theory, prior probability, conditional probability, inference using full joint distribution, Bay's rule, Probabilistic Reasoning, Bayesian Networks, Exact Inference In Bayesian networks, inference by enumeration, Using Of Certainty Factory, Different Models For Handling Uncertainty And Its Reasoning For A.I., Case Study Of MYCIN	8
VIII	Learning, forms of learning, inductive learning, learning decision trees, ensemble learning, logical formulation of learning, knowledge in learning, explanation based learning, learning using relevance information, inductive logic programming.	7

Suggested Readings:

1. Elaine Rich and Kevin Knight, "Artificial Intelligence", McGraw-Hill, India, 2017, Third Edition.
2. Dan W. Patterson, "Artificial Intelligence and Expert Systems", Prentice Hall of India,2015

3. Stuart Russell, Peter Norvig, "Artificial Intelligence – A Modern Approach", Pearson Education, 2010, Third Edition

4. N.P.Padhy, "Artificial Intelligence and Intelligent Systems",Oxford University Press, USA 2005

This course can be opted as an elective by the students of following subjects:

B.Sc. in Electronics, B.Sc. in Physics, B.Sc. in Statistics, B.Sc. in Mathematics, B.Sc. in Engineering, B.Sc. Vocational, BCA, Bachelor in Fine Arts. B.E. , B.Tech, B.A. (Maths), B.A.(Phil) with knowledge of mathematics up to class 12'th, B.A.(Psychology) knowledge of mathematics up to class 12'th.

Suggested Continuous Evaluation Methods:

2 Periodical Tests(each of 7.5 marks) + one seminar (5 marks) + 3 marks of assignment + 2 marks of Class Interaction

Course prerequisites:

To study this course, a student must have had the subject Mathematics in class 12th and elementary knowledge of any Computer Programming Language.

Suggested equivalent online courses:

http://ugcmoocs.inflibnet.ac.in/ugcmoocs/view_module_pg.php/1464

Further Suggestions:

List of Open Source Software/learning website:

1. http://www.journals.elsevier.com/artificial-intelligence/
2. https://www.technologyreview.com/s/534871/our-fear-of-artificial-intelligence/
3. http://www.sanfoundry.com/artificial-intelligence-maps-inductive-logic-unification-lifting-1/

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Programme/Class: B.Sc. (Research) In Science	Year: Fourth	Semester: Seven
Subject: Computer Science		
Course Code: 8070703T	Course Title: Software Engineering	

Course outcomes:

CO1 Describe software engineering layered technology and process framework.
CO2 Introduces theories, models, and techniques that provide a basis for the software development life cycle.
CO3 Introduces software testing approaches including verification and validation, static analysis, reviews, inspections, and audits.
CO4 Understanding of the role of project management including planning, scheduling, risk management, etc.
CO5 Work as an individual and/or in team to develop and deliver quality software.

Credits: 4	Core Compulsory
Max. Marks: 25+75	Min. Passing Marks:

Total No. of Lectures-Tutorials-Practical (in hours per week): 4-0-0

Unit	Topic	No. of Lectures
I	**Software Engineering Fundamentals:** Definition of Software, Software characteristics, Software Applications. Software Process: Software Process Models - Waterfall model, prototyping model, spiral model, Incremental model, concurrent development model. Project management Concepts: The Management Spectrum - The People, The Product, The Process, The Project.	11

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II	**Software Process and Project Metrics** : Measures , Metrics and Indicators , Software measurement Size - Oriented Metrics , Function - Oriented Metrics , Extended Function point metrics	4
III	**Software Project Planning:** Project Planning Objectives, Software Project Estimation , Decomposition Techniques - Problem Based Estimation Process Based Estimation Empirical Estimation Models- The COCOMO Model Risk Analysis and Management: Software risks, Risk Identification, Risk Projection, Risk Refinement, Risk Mitigation , Monitoring and Management.	11
IV	**Software Quality Assurance:** Basic concepts- Quality, Quality Control, Quality Assurance, Cost of Quality , Software Quality Assurance (SQA) , Formal Technical Review	4
V	**Software Configuration Management** Baselines , Software Configuration Items, The SCM Process, Version Control, Change Control, Configuration Audit, Status Reporting. Analysis Concepts and Principles: Requirements Elicitation for Software, Analysis Principles. The Information Domain, Modeling, Partitioning, Essential and Implementation Views, Specification: Specification Principles, Representation, The Software Requirement Specification (SRS)	8
VI	**Design Concepts and Principles:** Design Principles, Design Concepts – Abstraction, Refinement, Modularity, Software Architecture, Control Hierarchy, Structural Partitioning, Data Structure, Software Procedure, Structure, Information Hiding, Effective Modular Design- Cohesion, Coupling	7
VII	**Software Testing** :Testing Objectives & principles, Unit Testing, Integration Testing (Top Down Integration , Bottom Up Integration, Regression Testing, Smoke Testing), Validation Testing (Alpha and Beta Testing), System Testing (Recovery Testing, Security Testing, Stress Testing, Performance Testing).	7
VIII	**UNIT-V Reengineering:** Software Reengineering, Reverse Engineering, Restructuring, Forward Engineering CASE Tools: What is CASE, Building Blocks of CASE, A Taxonomy of CASE Tools, Integrated CASE Environments, The Integration Architecture, The CASE Repository.	8

Suggested Readings:

1. Roger S.Pressman, Software engineering- A practitioner's Approach, McGraw-Hill
2. Ian Sommerville, Software engineering, Pearson education Asia, 6th edition, 2000.
3. Pankaj Jalote- An Integrated Approach to Software Engineering, Springer Verlag, 1997.
4. James F Peters and Witold Pedrycz, "Software Engineering – An Engineering Approach",

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Khandari Campus Agra-282002

Programme/Class: M.Sc. (Computer Science)	Year: Fourth	Semester: VII
Subject: Computer Science		
Course Code: 8070901T	Course Title: Information and Network Security	

Course outcomes: After the completion of the course, the students will be able:

CO1: To understand the concepts of information security and their need and application.

CO2: To understand the network security services and mechanisms.

CO3: To apply cryptographic algorithms for information and network security.

CO4: To learn the concept of key, key management, key distribution in cryptographic systems.

CO5: To understand Data Integrity, Authentication, Digital Signatures Biometric Security Systems.

Credits: 4	Core Compulsory
Max. Marks: 25+75	Min. Passing Marks:

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0

Unit	Topics	No. of Lectures
I	Information security, Information Management Technologies, Security policies, Policy enforcement & related issues, Components of Information System, Security Models, Balancing Information Security and Access, Cipher Model, Stream ciphers and block ciphers, Cryptography, Cryptanalysis, Attacks, Substitution and Transposition techniques,Web Security threats, Internet Security Protocols.	8
II	Symmetric and asymmetric key cryptography, Symmetric key Ciphers: DES structure, DES Analysis, Security of DES, variants of DES, Multiple encryption and triple DES, Electronic Code Book, Block cipher modes of operation, Cipher Block Chaining Mode, AES structure, Analysis of AES.	8
III	Asymmetric key Ciphers, Random number generation, Fundamentals of entity authentication, Zero-knowledge mechanisms, Cryptographic Protocols, Authentication and key establishment protocols, Principles of public key cryptosystems, Public Key Cryptosystems with Applications, Requirements and Cryptanalysis, RSA algorithm, its computational aspects and security.	8
IV	Cryptographic MAC and Hash Functions, their applications, Simple hash functions, its requirements and security, Hash functions based on Cipher Block Chaining, Secure Hash Algorithm (SHA), Whirlpool, HMAC.	7
V	Key management fundamentals, Key lengths and lifetimes, Key generation, Key establishment, Key storage, Key	8

Head
Department Of Computer Science
IET, Dr. Bhimrao Ambedkar University
Khandari Campus Agra-282002

	usage, Governing key management, Public-Key Management, Certification of public keys, certificate lifecycle, Public-key management models, Key distribution, symmetric key distribution, Diffie-Hillman Key Exchange algorithm, Man-in-Middle attack.	
VI	Digital Signature, its properties, requirements and security, various digital signature schemes (Elgamal and Schnorr), NIST digital signature algorithm, Defining Intrusion Detection, Security concepts intrusion Detection concept, determining strategies for Intrusion Detection, Responses, Vulnerability Analysis, Credentialed approaches, Technical issues.	7
VII	Remote user authentication with symmetric and asymmetric encryption, Kerberos, IPSec, Secure Socket Layer (SSL), Transport Layer Security (TLS), Secure Electron c Transaction (SET), Pretty Good Privacy (PGP), S/MIME.	7
VIII	Biometric Fundamentals, Types of Biometrics, Fingerprints and Hand Geometry, Facial and Voice Recognition, Iris and Retina scanning, Signature Recognition and Keystroke Dynamics, Behavioral and Esoteric Biometric Technologies, Issues involving Biometrics, Privacy, Policy and Legal Concerns Raised by Biometrics.	7

Suggested Readings:

1. William Stallings, "Cryptography And Network Security: Principles and Practice," Sixth Edition, Pearson Education, 2013.
2. Mark Stamp, "Information Security Principles and Practice," Willy India, 2006.
3. Forouzan and Mukhopadhyay, "Cryptography & Network Security," Second Edition, McGraw Hill Education, 2010.
4. Atul Kahate, "Cryptography and Network Security," Fourth Edition, McGraw Hill, 2019.
5. C K Shyamala, N Harini, T R Padmanabhan, "Cryptography and Security," Wiley-India, 2011.
6. Goodboe, "Information Systems Security: Security Management, Metrics, Frameworks and Best Practices," Second Edition, Wiley, 2017.

This course can be opted as an elective by the students of following subjects:

B.Sc. In Electronics, B.Sc. In Physics, B.Sc. In Statistics, B. Sc. Mathematics, B.Sc. In Engineering, B.Sc. Vocational, BCA, B.E./B.Tech, M.E. / M. Tech

Suggested Continuous Evaluation Methods:

2 Periodical Tests(each of 5 marks) + 10 marks for the submission of any two programs written in any programming language from the given list + 3 marks of assignment + 2 marks of attendance

Course prerequisites:

Mathematical concepts including number theory, random numbers, and basic concepts of computer networks and communication

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Programme/Class: B.Sc. (Research) In Science	Year: Fourth	Semester: VIII
Subject: Computer Science		
Course Code: B070801T	Course Title: Digital Image Processing	

Course outcomes:

The student will be able to understand the basics of Computer Graphics, he/she will be able to do certain operations of graphics such as drawing different shapes, editing of these shapes. The student would be able to do 2D and 3D Transformations like translation, scaling, rotation, reflection and many more.

The student will be able to understand the basics of Digital Image processing, he/she will be able to perform transformations on images to enhance the quality of these images. The student would be able to understand about various filters that can be applied on images to enhance an image or to restore that image. He/she would be able to detect a point, a line or an edge from the images and he/she would also understand the several techniques to compress an image.

Credits: 4	Core Compulsory
Max. Marks: 25+75	Min. Passing Marks:

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0

Unit	Topics	No. of Lectures
I	**Introduction:** Pixel, Frame, Buffer, Applications Of Computer Graphics, Graphic Displays- Random Scan Displays, Raster Scan Displays, Points And Lines, Line Drawing Algorithms, Circle Generating Algorithms, Polygon Generation And Polygon Filling Algorithm	6
II	**2DTransformations:** Translation, Scaling, Rotation, Reflection, Homogeneous Coordinates , Matrix Representations, Composite Transformations, Reflections And Shearing. **Three Dimensional:** 3-D Geometric Primitives, 3-D Object	8

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Khandari Campus Agra-282002

	Representation, 3-D Transformation: : Translation, Scaling, Rotation, 3-D Viewing, Projections, 3-D Clipping.	
III	**Windowing And Clipping**: 2-D Clipping Algorithms- Line Clipping Algorithms Like Cohen Sutherland Line Clipping Algorithm, Liang Barsky Algorithm, Polygon Clipping – Sutherland Hodgeman Polygon Clipping, Text Clipping	6
IV	**DIGITAL IMAGE FUNDAMENTALS**: Applications, Steps in Digital Image Processing – Components of Digital Image Processor, Image Acquisition **IMAGE DIGITIZATION**: Image Sampling and Quantization, Representing Digital Images, Spatial and Gray level resolution, Zooming and Shrinking, Relationships between pixels: neighbors of a pixel, Adjacency, Connectivity, Regions, Boundaries, Color Image fundamentals : RGB	8
V	**IMAGE ENHANCEMENT IN SPATIAL DOMAIN**: Gray level transformations, Histogram processing: Histogram Equalization, Histogram Matching, Basics of Spatial Filtering, Smoothing and Sharpening Spatial Filtering **IMAGE ENHANCEMENT IN FREQUENCY DOMAIN**: Introduction to Fourier Transform, DFT, DCT, Walsh Hadamard, Smoothing and Sharpening frequency domain filters : Ideal, Butterworth and Gaussian filters(low pass and high pass filters)	8
VI	**IMAGERESTORATION** : Image Restoration , degradation model, Properties, Noise models , Mean Filters, Order Statistics, Adaptive filters, Band reject Filters, Band pass Filters, Notch Filter, Inverse Filtering , Wiener Filtering	8
VII	**IMAGE SEGMENTATION**: Point detection, Line detection, Edge detection, Edge linking via Hough transform , Region based segmentation ,Morphological processing- erosion and dilation, Segmentation by morphological watersheds	8
VIII	**IMAGE COMPRESSION AND RECOGNITION**: Need for data compression, Lossy compression: Transform coding, Lossless Compression: Huffman, Run Length Encoding, Arithmetic coding, JPEG standard, MPEG, Fidelity criteria.	8

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Khandari Campus Agra-282002

Programme/Class: B.Sc. (Research) In Science	Year: Fourth	Semester: Eighth
Subject: Computer Science		
Course Code: B070802T	Course Title: Mobile Applications	

Course outcomes:

After the completion of the course the students will be able to:

1. Understands the basic concepts of event driven programming.
2. Design and implement mobile applications.
3. Understand data persistence.
4. Perform Remote Data-Storage and Communication.

Credits: 4	Core Compulsory
Max. Marks: 25+75	Min. Passing Marks:
Total No. of Lectures-Tutorials-Practical (in hours per week): 4-0-0	

Unit	Topic	No. of Lectures
I	**Event Driven Programming:** UI event loop, Threading for background tasks, Outlets / actions, delegation, notification, Model View Controller (MVC) design pattern.	7
II	**Mobile application issues:** limited resources (memory, display, network, file system), input / output (multi-touch and gestures), sensors (camera, compass, accelerometer, GPS)	8
III	**Development tools:** Apple IOS toolchain: Objective-C, Xcode IDE, Interface Builder, Device simulator.	7

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IV	**Frameworks**: Objective-C and Foundation Frameworks, Cocoa Touch, UIKit, Others: Core Graphics, Core Animation, Core Location and Maps, Basic Interaction.	8
V	**Common UI's for mobile devices**: Navigation Controllers, Tab Bars, Table Views, Modal views, UI Layout.	7
VI	**Data Persistence**: Maintaining state between application invocations, File system, Property Lists, SQLite, Core Data	8
VII	**Remote Data-Storage and Communication**: "Back End" / server side of application, RESTful programming, HTTP get, post, put, delete, database design, server side JavaScript / JSON	8
VIII	**Code signing**: security, Keychain, Developers and App Store License Agreement	7

Suggested Readings:

1. Rajiv Ramnath, Roger Crawfis, and Paolo Sivilotti, Android SDK 3 for Dummies, Wiley, 2011.
2. Valentino Lee, Heather Schneider, and Robbie Schell, Mobile Applications: Architecture, Design, and Development, Prentice Hall, 2004.
3. Brian Fling, Mobile Design and Development, O'Reilly Media, 2009. Maximiliano
4. Firtman, Programming the Mobile Web, O'Reilly Media, 2010.
5. Christian Crumlish and Erin Malone, Designing Social Interfaces, O'Reilly Media, 2009.

This course can be opted as an elective by the students of following subjects:
B. Sc in Engineering, BCA, MCA, M.Sc.(IT)

Suggested Continuous Evaluation Methods: **Max. Marks: 25**

1. Assessment Type: Class Tests (Max. Marks 14)
2. Assessment Type: Quizzes/ Objective Tests / Recognition Type (such as MCQs; True or False; Matching; Classifying) /Recall Type -Filling Blanks; One word / Phrase Answers (Max Marks: 5)
3. Assessment Type: Assignments (Max Marks: 4)
4. Assessment Type: Class Interaction (Max. marks: 2)

Course prerequisites:
To study this course, a student must have had the subject **Data Structures, DBMS, Operating System, Object Oriented Programming with C++**

Suggested equivalent online courses:
1. https://onlinecourses.nptel.ac.in/noc20_cs52/preview
2. https://nptel.ac.in/courses/106/106/106106156/

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Department Of Computer Science
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Khandari Campus Agra-282002

Programme/Class: B.Sc. (Research) in Science	Year: Fourth	Semester: Eighth
Subject: Computer Science		
Course Code: B070803T	Course Title: Quantum Information	

Course outcomes:

Students would learn the framework of quantum computation, and how that may be useful for future quantum technologies. This course teaches the fundamentals of quantum information processing, including quantum computation, quantum cryptography, and quantum information theory. The last 20 years have seen the discovery of algorithms that directly harness the laws of quantum mechanics to speed up certain computations and ensure secrecy of communications. There are fast quantum algorithms to factor large integers and compute discrete logarithms, which, if implemented, threaten the security of the encryption schemes in common use today. This possibility has spurred several major and ongoing attempts to build quantum computers. Quantum computation might also be useful in simulating complex quantum systems such as large molecules.

Course Objective: The main objective of the course is to provide the student with the basic understanding of quantum computation and quantum information. Following objectives will cover:

- Understanding of quantum bits and quantum gates
- Analyze the behavior of basic quantum algorithms
- Implement simple quantum algorithms and information channels in the quantum circuit model
- Simulate a simple quantum error-correcting code
- Prove basic facts about quantum information channels

This course will primarily focus on the mathematical and computer science aspect of it. It will start the by answering "Why quantum computing?" and then move on to study the basic linear algebra and computer science needed to understand the theory of quantum computation. Then it will explore the idea of quantum circuit model in which most of the quantum algorithms are designed. The final part of the course will look at quantum algorithms and advantage they offer over classical computer.

Head
Department Of Computer Science
IET, Dr. Bhimrao Ambedkar University
Khandari Campus Agra-282002

Credits: 4	Core Compulsory
Max. Marks: 25+75	Min. Passing Marks:
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0	

Unit	Topics	No. of Lectures
I	Introduction to Quantum computing: History of quantum computation and quantum information, quantum bits, general view of quantum computation, quantum circuits, algorithms, operations,Qubits versus classical bits, Bloch sphere representation of a qubit, multiple qubits	8
II	Background Mathematics and Physics: Hilber space, Bases and linear independence, Linear operators and matrices, Pauli matrices, Inner products, Eigenvectors and Eigen values,Adjoint and Hermitian operators, Tensor product, operator functions,	7
III	Postulates of quantum mechanics: State space, Evolution, quantum measurement, Distinguishing quantum states, projective measurement, phase, composite system, density operator, EPR and the Bell Inequality	7
IV	Quantum Circuits: single qubit gates, multiple qubit gates, design of quantum circuits, Quantum algorithms, single qubit operations, controlled operations, measurement, universal quantum gates, quantum circuit model for computation, simulation of quantum systems	8
V	Quantum Information and Cryptography: Comparison between classical and quantum information theory. Bell states. Quantum teleportation. Quantum Cryptography, no cloning theorem.	8
VI	Quantum Algorithms: Classical computation on quantum computers. Relationship between quantum and classical complexity classes. Deutsch's algorithm, Deutsch-Jozsa algorithm, Shor factorization, Grover search.	7
VII	Noise and error correction: classical noise and Markov process, quantum operations, Axiomatic approach to quantum operations, examples of quantum noise and quantum operations, application of quantum operations	8

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Department Of Computer Science
IET, Dr. Bhimrao Ambedkar University
Khandari Campus Agra-282002

VIII	Quantum error correction: Introduction, three qubit bit flip code, three qubit phase flip code, the Shor code, Discretization of the errors, Independent error models, Degenerate codes, the quantum Hamming bound, classical linear code, calderbank-Shore-Steane codes	7

Suggested Readings:

1. Quantum Computation and Quantum Information: Michael A. Nielsen and Isaac L. Chuang, Cambridge University Press, 2010
2. Benenti G., Casati G. and Strini G., Principles of Quantum Computation and Information, Vol. I: Basic Concepts, Vol II: Basic Tools and Special Topics, World Scientific. 2004
3. 3 Pittenger A. O., An Introduction to Quantum Computing Algorithms 2000

This course can be opted as an elective by the students of following subjects:

B.Sc. In Electronics, B.Sc. In Physics, B.Sc. In Statistics, B. Sc. Mathematics, B.Sc. In Engineering, B.Sc. Vocational, BCA, B.E./B.Tech, M.E. / M. Tech

Suggested Continuous Evaluation Methods:

2 Periodical Tests(each of 5 marks) + 10 marks for the submission of any two programs written in any programming language from the given list + 3 marks of assignment + 2 marks of attendance.

Course prerequisites:

There are no formal prerequisites for this course. Informally, student should be familiar with calculus and linear algebra, and know some probability and discrete math. Knowledge of quantum mechanics is NOT a prerequisite; quantum concepts will be introduced as needed. Similarly, knowledge of algorithms and complexity are not prerequisites either; these also will be introduced as needed.

Suggested equivalent online courses:

Learning website: https://learnprc.mit.edu/quantum-computing,
https://www.coursera.org/learn/quantum-computing-algorithms,
https://www.coursera.org/projects/programming-quantum-computer-qiskit

List of experiments using Qiskit library

1. Implement the multi-qubits and show the various quantum operations.
2. Implement the Quantum circuit for preparing the Bell state.
3. Implement the different quantum gates and show the outcomes.
4. Implement the measurement of state.
5. Implement the Deutsch's algorithm.
6. Implement the Deutsch's-Jozsa algorithm
7. Implement the algorithm of Shor factorization.
8. Implement the Grover search.
9. Create a system of a single qubit in the state |0>, and using it to create a QuantumCircuit using the Identity operator.
10. Implement the Perfect Coin Algorithm.

Head
Department Of Computer Science
IET, Dr. Bhimrao Ambedkar University
Khandari Campus Agra-282002

Programme: Bachelor (Research) in Science	Year: Fourth	Semester: VIII
Subject: Computer Science		
Course Code: B071001T	Course Title: Advance Design and Analysis of Algorithms	
Course Outcomes:		
Credits:	Core Compulsory	
Max Marks: 25+75	Min Passing Marks:	
Total No. of Lectures – Tutorial – Practical (in Hours per week): L-T-P: 4:0:0		

Unit	Topics	No. of Lectures
I	Introduction: Algorithms, Analyzing Algorithms, Complexity of Algorithms, Growth of Functions, Performance Measurements, Sorting and Order Statistics - Shell Sort, Quick Sort, Merge Sort, Heap Sort, Comparison of Sorting Algorithms, Sorting in Linear Time	08
II	Advanced Data Structures: Red-Black Trees, B – Trees, Binomial Heaps, Fibonacci Heaps, Tries, Skip List	08
III	Divide and Conquer with Examples Such as Sorting, Matrix Multiplication, Convex Hull and Searching. Greedy Methods with Examples Such as Optimal Reliability Allocation, Knapsack, Minimum Spanning Trees – Prim's and Kruskal's Algorithms, Single Source Shortest Paths - Dijkastra's and Bellman Ford Algorithms.	08
IV	Dynamic Programming with Examples Such as Knapsack. All Pair Shortest Paths – Warshal's and Floyd's Algorithms, Resource Allocation Problem. Backtracking, Branch and Bound with Examples Such as Travelling Salesman Problem, Graph Coloring, n-Queen Problem, Hamiltonian Cycles and Sum of Subsets.	08
V	Selected Topics: Algebraic Computation, Fast Fourier Transform, String Matching, Theory of NP Completeness, Approximation Algorithms and Randomized Algorithms	08

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Khandari Campus Agra-282002

Suggested Readings:

1. Thomas H. Coreman, Charles E. Leiserson and Ronald L. Rivest, "Introduction to Algorithms", Printice Hall of India.
2. E. Horowitz & S Sahni, "Fundamentals of Computer Algorithms",
3. Aho, Hopcraft, Ullman, "The Design and Analysis of Computer Algorithms" Pearson Education, 2008.
4. LEE "Design & Analysis of Algorithms (POD)",McGraw Hill
5. Richard E.Neapolitan "Foundations of Algorithms" Jones & Bartlett Learning
6. Jon Kleinberg and Éva Tardos, Algorithm Design, Pearson, 2005.
7. Michael T Goodrich and Roberto Tamassia, Algorithm Design: Foundations, Analysis, and Internet Examples, Second Edition, Wiley, 2006.
8. Harry R. Lewis and Larry Denenberg, Data Structures and Their Algorithms, Harper Collins, 1997 9. Robert Sedgewick and Kevin Wayne, Algorithms, fourth edition, Addison Wesley, 2011.
10. Harsh Bhasin,"Algorithm Design and Analysis",First Edition,Oxford University Press.
11. Gilles Brassard and Paul Bratley, Algorithmics:Theory and Practice, Prentice Hall,1995

This course can be opted as an elective by the students of following subjects:

B.Sc. in Electronics, B.Sc. in Physics, B.Sc. in Statistics, B.Sc. in Engineering, B.Sc. Vocational, BCA, Bachelor in Fine Arts., B.E./ B.Tech.

Suggested Continuous Evaluation Methods: Max.Marks:25
1. Assessment Type: Class Tests (Max. Marks14)
2. Assessment Type: Quizzes / Objective Tests/ Recognition Type (such as MCQs; True or False; Matching; Classifying) / Recall Type- Filling Blanks; One word / Phrase Answers (Max Marks:5)
3.Assessment Type: Assignments (Max Marks:4)
4.Assessment Type: Class Interaction (Max Marks:2)

Course prerequisites:
To study this course, a student must have had the subject Software Engineering

Suggested equivalent online courses

Further Suggestions:
None

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Khandari Campus Agra-282002

Programme/Class: Bachelor(Research) In Science	Year: Fifth	Semester: IX
Subject: Computer Science		
Course Code: B070501T	Course Title: Artificial Neural Networks	

Course outcomes:

1. Get the exposure to Artificial Neural Networks.
2. Understand the Modeling of Neuron and Express both Artificial Intelligence and Neural Network
3. Analyze ANN learning, Error correction learning, Memory-based learning, Hebbian learning, Competitive learning and Boltzmann learning.
4. Implement Simple Perceptron, Perceptron learning algorithm, Convergence theorem, linear classifier and limitation of perceptron architecture
5. Develop feed forward multilayer neural network, Develop Delta learning rule of the output layer and Radial basis network
6. Implementation of Recurrent neural networks, Analysis of Hopfield energy function and problem of local minima.
7. Implementation of stochastic Hopfield neural network, simulated annealing and Boltzmann machine.
8. Get the exposure of Self organizing Map, ART and Neocognitron.

Credits: 4	Core Compulsory
Max. Marks: 25+75	Min. Passing Marks:

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0

Unit	Topics	No. of Lectures
I	Introduction to Neural Networks: Neural Network, Human Brain, Pattern and data, pattern recognition tasks, Models of Neuron, Neural networks viewed as directed graphs, Biological Neural Network, Artificial neuron, Artificial Neural Network architecture, ANN learning, analysis and applications, Topology of artificial neural networks.	7

Head
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Khandari Campus Agra-282002

II	Activation and synaptic dynamics: Activation dynamics model, Bidirectional associative memory, Lyapunov function analysis for stability, fixed point stability, Grossberg activation models, Synaptic dynamics models, learning equation, types of learning, requirements of learning laws, Learning methods (Hebbian learning, Competitive learning, Error correction learning, Reinforcement learning)	8
III	Linear associator, Supervised Hebbian learning and its analysis, Single layer Perception, Pattern classification, Linear classifier, Simple Perceptron, Perceptron learning algorithm, Convergence Theorem and Limitation of Perception.	7
IV	Feed forward ANN, Structures of Multi-layer feed forward networks, Back propagation algorithm, Back propagation - training and convergence, Functional approximation with back propagation, Practical and design issues of back propagation learning	8
V	Radial Basis Function Networks, Pattern separability and interpolation, Regularization Theor Regularization and RBF networks,RBF network design and training, Approximation properties of RBF.	7
VI	Feedback neural networks: Pattern storage and association, Hopfield model, Energy analysis of Hopfield network, Problem of false minima, Stochastic networks, Equilibrium of stochastic networks, Stability in stochastic networks, operation of a stochastic network, simulated annealing, Architecture of a Boltzmann machine, Boltzmann learning law	8
VII	Competitive Learning neural networks: Introduction, Components of competitive learning networks, Basic competitive Learning, Pattern Clustering, linear Vector Quantization, Analysis of feature mapping network, Self organizing map	7
VIII	Classical ART Network, Simplified ART Architecture,ART1 and ART2 Architecture and algorithms, Applications, Sensitivities of ordering of data. Applications of ANN : Pattern classification – Recognition of Olympic games symbols, Recognition of printed characters. Neocognitron – Recognition of handwritten characters. NET Talk: to convert English text to speech. Recognition of consonant vowel (CV) segments, texture classification and segmentation	8

Head
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Khandari Campus Agra-282002

Suggested Readings:

1. B. Yegnanarayana "ARTIFICIAL NEURAL NETWORK" PHI Publication, 1998.
2. "Fundamentals of artificial neural networks" MIT press, Mohamad H. Hassoun , 1995
3. Kevin L. Priddy, Paul E. Keller, "Artificial neural networks: An Introduction" - SPIE Press, 2005
4. Nelson, Morgan, "Artificial neural network: Electronic implementations" – IEEE Press, 1990

This course can be opted as an elective by the students of following subjects:

B.Sc. In Electronics, B.Sc. In Physics, B.Sc. In Statistics, B. Sc. Mathematics, B.Sc. In Engineering, B.Sc. Vocational, BCA, B.E./B.Tech, M.E. / M. Tech

Suggested Continuous Evaluation Methods: **Max. Marks: 25**

1. Assessment Type: Class Tests (Max. Marks 14)
2. Assessment Type: Quizzes/ Objective Tests / Recognition Type (such as MCQs; True or False; Matching; Classifying) /Recall Type -Filling Blanks; One word / Phrase Answers (Max Marks: 5)
3. Assessment Type: Assignments (Max Marks: 4)
4. Assessment Type: Class Interaction (Max. marks: 2)

Course prerequisites:

Higher Engineering Mathematics e.g. linear algebra, multivariate calculus and Probability theory, Fundamental knowledge of signals and systems along with types, Mathematical representation of signals and system modeling in time as well as frequency domain. Transforms especially like Laplacian, Fourier and Z. Artificial Intelligence and Control system Engineering.

Suggested equivalent online courses:

Learning website: www.pcvr.nitl.edu, www.learnartificialneuralnetworks.com, www.neural-forecasting.com

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Khandari Campus Agra-282002

Programme/Class: **Master in Science (Computer Science)**	Year: **Fifth**	Semester: IX
Subject: **Computer Science**		
Course Code: B070903T	Course Title: **Machine Learning Techniques**	

Course outcomes: The students will be able to select and implement machine learning techniques and computing environment that are suitable for the applications under consideration., he will be able to solve problems associated with batch learning and online learning. Students will have the ability to understand and apply scaling up machine learning techniques and associated computing techniques and technologies. He would be able to recognize and implement various ways of selecting suitable model parameters for different machine learning techniques.

Credits: **4**	Elective
Max. Marks: **25+75**	Min. Passing Marks:

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: **4-0-0**

Unit	Topics	No. of Lectures
1	Introduction Class overview: Class organization, topics overview, Introduction: What is ML; Problems, Definition of learning systems, Goals and applications of machine learning. Aspects of developing a learning system: training data, concept representation, function approximation.	6

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Khandari Campus Agra-282002

II	**Linear regression**: SSE; gradient descent; closed form; normal equations; features, Overfitting and complexity; training, validation, test data, **Classification problems**; decision boundaries; nearest neighbor methods. Probability and classification, Bayes optimal decisions, Naive Bayes and Gaussian class-conditional distribution **Linear classifiers**, Bayes' Rule and Naive Bayes Model, **Logistic regression**, online gradient descent	7
III	**Decision Tree Learning** Representing concepts as decision trees. Recursive induction of decision trees. Picking the best splitting attribute: entropy and information gain. Searching for simple trees and computational complexity. Overfitting, noisy data, and pruning.	8
IV	**Ensemble Learning** Bagging, boosting, and DECORATE. Active learning with ensembles. **Experimental Evaluation of Learning Algorithms** Measuring the accuracy of learned hypotheses. Comparing learning algorithms: cross-validation, learning curves, and statistical hypothesis testing.	7
V	**Computational Learning Theory:** Models of learnability: learning in the limit; probably approximately correct (PAC) learning. Sample complexity: quantifying the number of examples needed to PAC learn. Computational complexity of training. Sample complexity for finite hypothesis spaces. PAC results for learning conjunctions, kDNF, and kCNF. Sample complexity for infinite hypothesis spaces, Vapnik-Chervonenkis dimension	8
VI	**Support Vector Machines** Kernels for learning non-linear functions. **Bayesian Learning** Probability theory and Bayes rule. Naive Bayes learning algorithm. Parameter smoothing. Generative vs. discriminative training. Logistic regression. Bayes nets and Markov nets for representing dependencies. k-Nearest-neighbor algorithm. Case-based learning. **Text Classification:** Bag of words representation. Vector space model Relevance feedback and Rocchio algorithm. Versions of nearest neighbor and Naive Bayes for text.	8

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IET, Dr. Bhimrao Ambedkar University
Khandari Campus Agra-282002

VII	**Clustering and Unsupervised Learning** Learning from unclassified data. Clustering. Hierarchical Agglomerative Clustering. k-means partitional clustering. Expectation maximization (EM) for soft clustering. Semi-supervised learning with EM using labeled and unlabled data.	8
VIII	**Language Learning** Classification problems in language: word-sense disambiguation, sequence labeling. Hidden Markov models (HMM's). Veterbi algorithm for determining most-probable state sequences. Forward-backward EM algorithm for training the parameters of HMM's. Use of HMM's for speech recognition, part-of-speech tagging, and information extraction.	8

Suggested Readings:

1. Tom M. Mitchell, "Machine Learning" , McGraw-Hill Education (India) Private Limited, 2013.

2. Ethem Alpaydin, "Introduction to Machine Learning " , The MIT Press 2004.

3. Stephen Marsland, "Machine Learning: An Algorithmic Perspective", CRC Press, 2009.

4. Dutt Saikat , "Machine Learning" ,Pearson

This course can be opted as an elective by the students of following subjects:

B.Sc. in Electronics, B.Sc. in Physics, B.Sc. in Statistics, B.Sc. in Engineering, B.Sc. Vocational, BCA, Bachelor in Fine Arts., B.E./B.Tech

Suggested Continuous Evaluation Method:

2 Periodical Tests(each of 5 marks) + 10 marks for the submission of any two programs written in any programming language from the given list + 3 marks of assignment + 2 marks of attendance.

Course prerequisites:

To study this course, a student must have had the subject Mathematics in class12th.

Suggested equivalent online courses:

Further Suggestions:

Programs:

Head
Department Of Computer Science
IET, Dr. Bhimrao Ambedkar University
Khandari Campus Agra-282002

Programme/Class: M.Sc. (Computer science)	Year: Fifth	Semester: IX
B0709027	Subject: Computer Science	
Course Code:	Course Title: Parallel Computing and Algorithms	

Course outcomes:

After the completion of the course the students will be able to:

1. Understands the difference between sequential and parallel mode.
2. Understands the parallel programming platforms.
3. Write parallel algorithm for different computational models.
4. Understaind parallel algorithms for different data structures

Credits: 4	Core Compulsory
Max. Marks: 25+75	Min. Passing Marks:

Total No. of Lectures-Tutorials-Practical (in hours per week): 4-0-0

Unit	Topic	No. of Lecture s
I	**Introduction to Parallel Computing:** Sequential model, need of alternative model, Motivating Parallelism, Scope of Parallel Computing.	4
II	**Parallel Programming Platforms:** Implicit Parallelism: Trends in Microprocessor Architectures, Limitations of Memory System Performance, Dichotomy of Parallel Computing Platforms, Physical Organization of Parallel Platforms, Communication Costs in Parallel Machines	8
III	**Parallel computational models:** PRAM, LMCC, Hypercube, Cube Connected Cycle, Butterfly, Perfect Shuffle Computers, Tree model, Pyramid model, Fully Connected model, PRAM-CREW, EREW models, simulation of one model from another one.	10
IV	**Performance Metrics:** Performance Measures of Parallel Algorithms, speed-up and efficiency of PA, Cost optimality, An example of illustrate Cost-optimal algorithms such as summation, Min/Max on various models.	8
	Parallel Sorting Networks: Parallel Merging Algorithms on CREW/EREW/MCC, parallel Sorting Networks on	7

Head
Department Of Computer Science
IET, Dr. Bhimrao Ambedkar University
Khandari Campus Agra-282002

V	CREW/EREW/MCC, linear array	
VI	**Parallel Searching Algorithm:** Kth element, Kth element in X+Y on PRAM, Parallel Matrix Transportation and Multiplication Algorithm on PRAM, MCC, Vector-Matrix Multiplication, Solution of Linear Equation, Root finding.	8
VII	**Graph Algorithms:-** Definitions and Representation, Minimum Spanning Tree: Prim's Algorithm, Single-Source Shortest Paths: Dijkstra's Algorithm, All-Pairs Shortest Paths, Transitive Closure, Connected components.	7
VIII	**Search Algorithms for Discrete Optimization Problems:** Definitions and Examples, Sequential Search Algorithms, Search Overhead Factor, Parallel Depth-First Search, Parallel Best-First Search, Speedup Anomalies in Parallel Search Algorithms	8

Suggested Readings:

1. M.J. Quinn, "Designing Efficient Algorithms for Parallel Computer" by Mc Graw Hill.
2. S.G. Akl, "Design and Analysis of Parallel Algorithms"
3. S.G. Akl, "Parallel Sorting Algorithm" by Academic Press.

This course can be opted as an elective by the students of following subjects:
B. Sc in Engineering, BCA, MCA, M.Sc.(IT)

Suggested Continuous Evaluation Methods: Max. Marks: 25

1. Assessment Type: Class Tests (Max. Marks 14)
2. Assessment Type: Quizzes/ Objective Tests / Recognition Type (such as MCQs; True or False; Matching; Classifying) /Recall Type -Filling Blanks; One word / Phrase Answers (Max Marks: 5)
3. Assessment Type: Assignments (Max Marks: 4)
4. Assessment Type: Class Interaction (Max. marks: 2)

Course prerequisites:
To study this course, a student must have had the subject Data Structures, Algorithm Design and Analysis, Computer Network, Computer Architecture.

Suggested equivalent online courses:

1. https://nptel.ac.in/courses/106/102/106102114/
2. https://www.coursera.org/learn/introduction-high-performance-computing

Further Suggestions:
None

Head
Department Of Computer Science
IET, Dr. Bhimrao Ambedkar University
Khandari Campus Agra-282002

Programme/Class: M.Sc (Computer Science)	Year: Fifth	Semester: IX

Subject: Computer Science

Course Code: B070906T	Course Title: Software Project Management

Course outcomes:

1. Apply the process to be followed in the SDLC models.
2. Able to understand communication, modeling, construction & deployment practices in software development.
3. Understand the concepts of various software testing methods.
4. Explain the quality management & different types of metrics used in software development.
5. Apply the concepts of project management & planning.

Credits: 4	Specialization Group B: Core Compulsory
Max. Marks: 25+75	Min. Passing Marks:

Total No. of Lectures-Tutorials-Practical (in hours per week): 4-0-0

Unit	Topic	No. of Lectures
I	**Introduction To Software Project Management:** Introduction, What Is a Project? Software Projects Versus Other Types of Project, Contract Management and Technical Project Management, Activities Covered by Software Project Management, Plans, Methods, and Methodologies, Some ways of Categorizing Software Projects, What Is Management?, Problems with Software Projects, Setting Objectives, Stakeholders, The Business Case, Requirement Specification, Management Control, Overview of Project Planning (Step wise)	8
II	**Project Evaluation & Selection Of An Appropriate Project Approach:** Introduction, Strategic Assessment, Technical Assessment, Cost-Benefit Analysis, Cash Flow Forecasting, Cost- Benefit Evaluation Techniques, Risk Evaluation. Selection Of An Appropriate Project Approach: Introduction, Choosing Technologies, Technical Plan-Contents List, Choice of Process Models, Structure Versus Speed of Delivery, The Waterfall Model, The V- Process Model, The Spiral Model, Software Prototyping, Other ways of Categorizing Prototyping, Controlling Changes during Prototyping, Incremental Delivery, Dynamic Systems Development Method, Extreme Programming, Managing Iterative Processes.	7
III	**Software Effort Estimation:** Introduction, Where are Estimates done?, Problems with Over-and Under- Estimates, The Basis for Software Estimating, Software Effort Estimation Techniques, Expert Judgement, Estimating by Analogy, Albrecht Function Point Analysis, Function Point Mark II, Object Points, A Procedural Code- Oriented Approach, COCOMO: A Parametric Model.	8
IV	**Activity Planning:** Introduction, The Objectives of Activity Planning, When to Plan, Project Schedules, Projects and Activities, Sequencing and Scheduling Activities, Network Planning Models, Formulating a Network Model, Adding the Time Dimension, The Forward Pass, The Backward Pass, Identifying the Critical Path, Activity Float, Shortening the Project Duration, Identifying Critical Activities, Activity- On – Arrow Networks.	7

Head
Department Of Computer Science
IET, Dr. Bhimrao Ambedkar University
Khandari Campus Agra-282002

V	**Risk Management & Resource Allocation:** Introduction, The Nature of Risk, Types of Risk, Managing Risk, Hazard Identification, Hazard Analysis, Risk Planning and Control, Evaluating Risks to the Schedule.Resource Allocation: Introduction, The Nature of Resources, Identifying Resources Requirements, Scheduling Resources, Creating Critical Paths, Counting the Cost, Being Specific, Publishing the Resources Schedule, Cost Schedules, The Scheduling Sequence.	7
VI	**Monitoring, Control & Managing Contracts:** Introduction, Creating the Framework, Collecting the Data, Visualizing Progress, Cost Monitoring, Earned Value, Prioritizing Monitoring, Getting the Project Back to Target, Change Control. Managing Contracts: Introduction, Types of Contract, Stages in Contract Placement, Typical Terms of a Contract, Contract Management, Acceptance.	8
VII	**Managing People And Organizing Teams:** Introduction, Understanding Behaviour, Organizational Behaviour: A Background, Selecting The Right Person For The Job, Instruction In The Best Methods, Motivation, The Oldham- Hackman Job Characteristics Model, Working In Groups, Becoming A Team, Decision Making, Leadership, Organizational Structures.	7
VIII	**Software Quality:** Introduction, The Place Of Software Quality In Project Planning, The Importance Of Software Quality, Defining Software Quality, ISO 9126, Practical Software Quality Measures, Product Versus Process Quality Management, External Standards, Techniques To Help Enhance Software Quality, Quality Plans.	8

Suggested Readings:

1. B.Hughes and M.Cotterell- Software Project Management 3rd Edn, TMH, New Delhi, 2004.
2. P.Jolote- Software Project Management in Practice, Pearson Education, New Delhi, 2002.

This course can be opted as an elective by the students of following subjects:
B. Sc in Engineering, BCA, MCA, M.Sc.(IT)

Suggested Continuous Evaluation Methods: **Max. Marks: 25**

1. Assessment Type: Class Tests (Max. Marks 14)
2. Assessment Type: Quizzes/ Objective Tests / Recognition Type (such as MCQs; True or False; Matching; Classifying) /Recall Type -Filling Blanks; One word / Phrase Answers (Max Marks: 5)
3. Assessment Type: Assignments (Max Marks: 4)
4. Assessment Type: Class Interaction (Max. marks: 2)

Course prerequisites:
To study this course, a student must have had the subject Software Engineering

Suggested equivalent online courses:

1. https://onlinecourses.nptel.ac.in/noc19_cs70/preview
2. https://nptel.ac.in/courses/106/105/106105218/
3. https://www.classcentral.com/course/swayam-software-project-management-14294

Further Suggestions:
None

Head
Department Of Computer Science
IET, Dr. Bhimrao Ambedkar University
Khandari Campus Agra-282002

Programme/Class: M.Sc. (Computer science)	Year: Fifth	Semester: Ninth
Subject: Computer Science		
Cource Code: B0709101	Course Title: **Software Testing and Audit**	

Course outcomes:

1. To understand Software Engineering, Testing Process, Terminologies in Testing, SRS
2. To understand different types of software testing (i.e. Functional Testing, Structural Testing)
3. To apply different types of testing with tools
4. To understand different types of Software Testing Activities (i.e Levels of Testing)
5. To understand Object Oriented Testing
6. To understand Testing Web Applications

Credits: 4	Specialization Group B: Elective
Max. Marks: 25+75	Min. Passing Marks:

Total No. of Lectures-Tutorials-Practical (in hours per week): 4-0-0

Unit	Topic	No. of Lectures
I	**Review of Software Engineering:** Overview of Software Evolution, SDLC, Testing Process, Terminologies in Testing: Error, Fault, Failure, Verification, Validation, Difference Between Verification and Validation, Test Cases, Testing Suite, Test ,Oracles, Impracticality of Testing All Data; Impracticality of Testing All Paths.	8
II	**Verification:** Verification Methods, SRS Verification, Source Code Reviews, User Documentation Verification, Software Project Audit, Tailoring Software Quality Assurance Program by Reviews, Walkthrough, Inspection and Configuration Audits.	7
III	**Functional Testing:** Boundary Value Analysis, Equivalence Class Testing, Decision Table Based Testing, Cause Effect Graphing Technique. **Structural Testing:** Control Flow Testing, Path Testing, Independent Paths, Generation of Graph from Program, Identification of Independent Paths, Cyclomatic Complexity, Data Flow Testing, Mutation Testing	8
IV	**Regression Testing:** What is Regression Testing? Regression Test cases selection, Reducing the number of test cases, Code coverage prioritization technique. **Reducing the number of test cases:** Prioritization guidelines, Priority category, Scheme, Risk Analysis.	7
V	**Software Testing Activities:** Levels of Testing, Debugging, Testing techniques and their applicability, Exploratory Testing	7

Head
Department Of Computer Science
IET, Dr. Bhimrao Ambedkar University
Khandari Campus Agra-282002

VI	**Automated Test Data Generation:** Test Data, Approaches to test data generation, test data generation using genetic algorithm, Test Data Generation Tools, Software Testing Tools, and Software test Plan.	8
VII	**Object Oriented Testing:** Definition, Issues, Class Testing, Object Oriented Integration and System Testing.	7
VIII	**Testing Web Applications:** Web Testing, User Interface Testing, Usability Testing, Security Testing, Performance Testing, Database testing, Post Deployment Testing.	8

Suggested Readings:

1. Yogesh Singh, "Software Testing", Cambridge University Press, New York, 2012
2. K.K. Aggarwal & Yogesh Singh, "Software Engineering", New Age International Publishers, New Delhi, 2003.
3. Roger S. Pressman, "Software Engineering – A Practitioner's Approach", Fifth Edition, McGraw-Hill International Edition, New Delhi,2001.
4. Mere Roper, "Software Testing", McGraw-Hill Book Co., London, 1994.
5. M.G. Trivedi, Software Testing & Audit, Khanna Publishing House
6. Boris Beizer, "Software System Testing and Quality Assurance", Van Nostrand Reinhold, New York, 1984.

This course can be opted as an elective by the students of following subjects:
B. Sc in Engineering, BCA, MCA, M.Sc.(IT)

Suggested Continuous Evaluation Methods: **Max. Marks: 25**

1. Assessment Type: Class Tests (Max. Marks 14)
2. Assessment Type: Quizzes/ Objective Tests / Recognition Type (such as MCQs; True or False; Matching; Classifying) /Recall Type -Filling Blanks; One word / Phrase Answers (Max Marks: 5)
3. Assessment Type: Assignments (Max Marks: 4)
4. Assessment Type: Class Interaction (Max. marks: 2)

Course prerequisites:
To study this course, a student must have had the subject Software Engineering

Suggested equivalent online courses:
1. https://onlinecourses.nptel.ac.in/noc19_cs71/preview/
2. https://onlinecourses.nptel.ac.in/noc20_cs19/preview
3. https://www.classcentral.com/course/swayam-software-testing-14295

Further Suggestions:
None

Head
Department Of Computer Science
IET, Dr. Bhimrao Ambedkar University
Khandari Campus Agra-282002

Programme: M.Sc. (Computer Science)	Year: Fifth	Semester: IX
Subject: Computer Science		
Course Code: B070914T	Course Title: Foundation of Data Science	
Course Outcomes:		
Credits:	Core Compulsory	
Max Marks: 25+75	Min Passing Marks:	
Total No. of Lectures – Tutorial – Practical (in Hours per week): L-T-P: 4:0:0		

Unit	Topics	No. of Lectures
I	Data visualization: Elements of data visualization, Exploration plots: Scatterplots, Line plots, barplots, boxplots, Advanced plots: correlation, regression, biplots, Reporting using visualization Keywords: seaborn, plotly. Data preparation: Handling missing data; imputation methods , Feature transformation and engineering. • Keywords: sklearn	08
II	Supervised learning: Linear models for regression: Linear models and non-linear feature maps, Model evaluation, Bias-Variance tradeoff, Penalized regression, Cross validation and model selection Linear models for classification: Logistic regression , Misclassification, ROC, AUC, Class imbalance Non-linear models: decision trees: Decision trees, Variable selection, Random Forests, Bagging and boosting, Keywords: sklearn, linear models, cross validation, regularization, lasso, trees, ensembles, boosting	08
III	Unsupervised learning: Clustering, PCA and SVD, Keywords: clustering, PCA	08
IV	STATISTICS FOR DATA SCIENCE: Introduction to Statistics, Harnessing Data, Exploratory Analysis, Distributions, Hypothesis & Computational Techniques, Correlation & Regression	08

Head
Department Of Computer Science
ET, Dr. Bhimrao Ambedkar University
Khandari Campus Agra-282002

V	PYTHON FOR DATA SCIENCE: Introduction to Data Science with Python, Python Basics: Basic Syntax, Data Structures, Data Objects, Math, Comparison Operators, Condition Statements, loops, lists, tuples, dicts, functions, Numpy Package, Pandas Package, Exploratory Data Analysis: Data Cleaning, Data Wrangling, Exploratory Data Analysis: Case Study VISUAL ANALYTICS FOUNDATION: Visual Analytics Basics, Basic Charts, Plots	08

Suggested Readings:

1. James, G., Witten, D. , Hastie, T. and Tibshirani, R., An introduction to Statistical Leanings with applications in R. Springer, 2013.
2. Hastie, T. , Tibshirani, R. and Friedman, J., The Elements of Statistical Learning. Springer, 2009.
3. Bishop, C.M. Pattern Recognition and Machine Learning. Springer, 2006

This course can be opted as an elective by the students of following subjects:

B.Sc. in Electronics, B.Sc. in Physics, B.Sc. in Statistics, B.Sc. in Engineering, B.Sc. Vocational, BCA, Bachelor in Fine Arts., B.E./ B.Tech.

Suggested Continuous Evaluation Methods: Max.Marks:25.
1. Assessment Type: Class Tests (Max. Marks14)
2. Assessment Type: Quizzes / Objective Tests/ Recognition Type (such as MCQs; True or False; Matching; Classifying) / Recall Type- Filling Blanks; One word / Phrase Answers (Max Marks:3)
3.Assessment Type: Assignments (Max Marks:4)
4.Assessment Type: Class Interaction (Max Marks:2)

Course prerequisites:
To study this course, a student must have had the subject Software Engineering

Suggested equivalent online courses

Further Suggestions:
None

Head
Department Of Computer Science
IET, Dr. Bhimrao Ambedkar University
Khandari Campus Agra-282002

Programme/Class: Master in Science (Computer Science)	Year: Fifth	Semester: X
Subject: Computer Science		
Course Code: B071002T	Course Title: Quantum Neural Networks	

Course outcomes:
Students would learn the framework of quantum neural networks, and how that may be useful for future machine intelligence technologies.This course teaches the fundamentals of quantum neural networks, including quantum computation, quantum gates, and entanglement with quantum states.There are fast quantum algorithms to factor large integers, compute discrete logarithms, and iterative process for operator construction which, if implemented, threaten the pattern recognitionisask. This possibility has spurred several major and ongoing attempts to build quantum computers. Quantum computation might also be useful in simulating complex quantum systems such as large molecules.

Credits: 4	Elective
Max. Marks: 25+75	Min. Passing Marks:

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0

Unit	Topics	No. of Lectures
I	What is Quantum, Quantum Computation, Quantum Algorithms, Quantum Information Processing, Principles of Quantum Computing, Postulates of Quantum Computing, Quantum Machine Learning (QML), Why QML?, Building Blocks of QML: Qubits, Superposition, Interference, Entanglement etc, Inherent Parallelism of Quantum Computing, Applications of QML.	8
II	Quantum Neural Networks (QNN), Why QNN? , Neural Computing, Quantum Computing, Neural Networks: Towards Quantum Analogs, How Pattern Recognition leads us to QNN, Many Universe Approach, Quantum Associative Memory, Classical Neural Networks vs Quantum Associative Memory, Implementation of QNN: Physicial realizations and challenges, Can QNN outperform Classical ANN ? Review of existing approaches to QNNs.	8
III	Quantum Gates, Controlled Operations, Matrix Representation of Multi Qubit Gates, Density Matrix, Density Operator, General Properties of Density Operator, Criteria for discrimination between mixed and pure state, Quantum Circuits and its Identities, Decomposition of Quantum Gates, Single Qubit Operations, Multi Qubit	8

Head
Department Of Computer Science
Dr. Bhimrao Ambedkar University
Khandari Campus Agra-282002

	Operations	
IV	QNN Models: A comparative study, Requirements for a QNN model, Concept of Quron, Implementation feasibility of Perceptron model for Boolean Reversible Functions through various Two Qubit Quantum Gates	8
V	Entangled Neural Networks (ENN), Construction of Entangled Neural Networks: Basic unit of ENN's and Structure of ENNs, Temperature adjusting problem and ENN's resolution	8
VI	Generalization Study of Quantum Neural Network: Qubit, Quantum Gates, Model Design, Data Encoding, Network Structure, Learning Algorithms, Simulating a perceptron on a quantum computer, Defining Quantum Neural Networks via Quantum Time Evolution	8
VII	Bell States, Quantum Teleportation and Superdense Coding: Principles, Proofs and Circuits, Entanglement Swapping etc, Quantum neural networks architectures for pattern classification& Clustering, pattern association and pattern mapping	8
VIII	Quantum Computing with MATLAB: Programming with QCF Library, and QETLAB 0.9 Library, Designing and Executing Quantum Circuits on Simulators such as: QCAD2000, QuIDE, Qiskit etc	8

Suggested Readings:

1. Quantum Neural Networks by AlexenderEzhov and Dan Ventura
2. Quantum Machine Learning by Peter Wittek
3. The quest for a Quantum Neural Networks by Maria Schuld, IlyaSinayskiy, and Francesco Petruccione
4. Simulating Perceptron on a Quantum Computer by Maria Schuld, IlyaSinayskiy, and Francesco Petruccione
5. Generalization Study of Quantum Neural Network by JinZhe Jiang, Xin Zhang, Chen Li, YaQian Zhao etc.
6. Quantum Neuron: an elementary building block for machine learning on quantum computers

This course can be opted as an elective by the students of following subjects:
B.Sc. in Electronics, B.Sc. in Physics, B.Sc. in Statistics, B. Sc. Mathematics, B.Sc. in Engineering, B.Sc. Vocational, BCA, B.E./B.Tech, M.E. / M. Tech

Suggested Continuous Evaluation Methods:
2 Periodical Tests(each of 5 marks) + 10 marks for the submission of any two programs written in any programming language from the given list + 3 marks of assignment + 2 marks

Head
Department Of Computer Science
IET, Dr. Bhimrao Ambedkar University
Khandari Campus Agra-282002

Programme/Class M.Sc (Computer Science)	Year: FIFTH	Semester: X
Subject: Computer Science		
Course Code: B071003T	Course Title: Deep Learning & Pattern Recognition	
Course Outcome: -Learning of basics of Deep learning's - Pattern Recognition - Image pattern		
Credit: 4		
Max. Marks: 25+75	Min. Passing Marks	

Unit	Topic	No. of lecture
I	Deep Learning Basics: Intro, History, Capabilities. The Perceptron Neural Network Learning: Back-Propagation. Autoencoders (Standard, Sparse, Denoising, Contractive, Etc), Variational Autoencoders, , Autoencoder And DBM Attention And Memory Models, Dynamic Memory Networks	8
II	Convolutional Neural Networks: Intro To Cnns, Convolution And Pooling Layers, Correlation, Filtering, Detection And Segmentation , Visualizing And Understanding , Advanced Cnns For Computer Vision. Advanced Deep Architectures: Recurrent Neural Networks (Rnns), Advanced RNN: LSTM, GRU, Deep Unsupervised Learning Deep Reinforcement Learning.	8
III	Deep Learning In NLP: Introduction To NLP And Vector Space Model Of Semantics. Word Vector Representations: Continuous Skip-Gram) Model, Continuous Bag-Of Words Model (CBOW), Glove, Evaluations And Applications In Word Similarity, Analogy Reasoning.	8
IV	Introduction: General introduction of pattern -recognition, pattern recognition tasks, difference between data and pattern, pattern classification, pattern association, pattern mapping, pattern : clustering, feature mapping, temporal pattern, pattern variability, stability plasticity dilemma, basic outline of various Pattern recognition techniques, Introduction to Statistical Pattern Recognition, Overview of Pattern Classifiers, overview of Linear Algebra: Inner product, outer product, inverses, eigen values, eigen vectors.	6
V	Bayesian decision making and Bayes Classifier: Probability: Independence of events, conditional and joint probability, Random Processes: Stationary and non-stationary processes, Expectation, Autocorrelation, Cross-Correlation, spectra, Bayes Decision Theory,Bayes'theorem, Minimum-error-rate classification, Classifiers, Discriminant functions, Decision surfaces, Normal density and discriminant functions, discrete features.	7
VI	Parametric Estimation of Densities: Maximum-Likelihood estimation: Gaussian case; Maximum a Posteriori estimation; Bayesian estimation of parameters of density functions, MAP _ estimates, Bayesian Estimation examples, the exponential family of densities and ML estimates, Recursive formulation of ML and Bayesian estimates	8
VI	Unsupervised learning and _ clustering: Criterion functions for clustering; Algorithms for clustering: K-Means, Hierarchical and other methods; Cluster validation; Gaussian mixture models; Expectation-Maximization method for parameter estimation Maximum entropy estimation.	8

Head
Department Of Computer Science
Dr. Bhimrao Ambedkar University
Khandari Campus Agra-282002

Program: M.Sc. (Computer Science)	Year: Fifth	Semester: X
Subject: Computer Science		
Course Code: B071004T	Computer Vision	
Course Outcomes:		
Credits:	Core Compulsory	
Max Marks: 25+75	Min Passing Marks:	
Total No. of Lectures – Tutorial – Practical (in Hours per week): L-T-P: 4:0:0		

Unit	Topics	No. of Lectures
I	**Introduction and Image Formation:** Introduction to computer vision, historic perspective and recent challenges, Geometric primitives and transformations, Photometric image formation, digital camera	08
II	**Image processing:** Point operators, Linear filtering, Nonlinear filtering Fourier transforms, Pyramids and wavelets Geometric transformations, Model fitting and optimization	08
III	**Deep Learning:** Supervised, Unsupervised learning, Deep neural network, Convolutional neural networks, transformers, and generative models	08
IV	**Recognition:** Instance recognition, Image classification Object detection Semantic segmentation	08
V	**Feature detection and matching:** Points and patches, Edges and contours, Contour tracking, Lines and vanishing points Segmentation	08
VI	**Image alignment and stitching:** Pairwise alignment Image stitching Global alignment Compositing, Applications	08
VII	**Motion estimation:** Translational alignment Parametric motion Optical flow Layered motion, Applications Structure from motion: Geometric intrinsic calibration Pose estimation	08
VIII	Depth estimation Epipolar geometry, Sparse correspondence Dense correspondence Local methods Global optimization Applications. Image-based rendering: View interpolation, Video-based rendering Applications	08

Head
Department Of Computer Science
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Programme/Class: M.Sc. (Computer science)	Year: Fifth	Semester: Tenth
—	Subject: Computer Science	
Course Code: 8071009T	Principal of Software Reliability Engineering	

Course outcomes:

1. Have an understanding of the terminology, the process and the models of the software reliability engineering
2. Have learned techniques to predict and measure reliability of the software systems
3. Know how to improve reliability during the various stages of the SDLC.

Credits: 4	Specialization Group B: Elective

Head
Department Of Computer Science
IET, Dr. Bhimrao Ambedkar University
Khandari Campus Agra-282002

Max. Marks: 25+75	Min. Passing Marks:

Total No. of Lectures Tutorials Practical (in hours per week): 4-0-0

Unit	Topic	No. of Lectures
I	**Introduction:** The Need for Software Reliability, Software Reliability Engineering, Why Does Software Cost So Much? Basic Definitions and Terminologies.	7
II	**Reliability Engineering Measures:** Reliability Definitions, System Mean Time to Failure, Failure Rate Function, Reliability Function for Common Distributions, Maintainability and Availability.	9
III	**Software Engineering Assessment:** Introduction, Software Versus Hardware Reliability, Software Reliability and Testing Concepts, Software Lifecycle, Software Development Process and its Applications, Software Verification and Validation, Data Collection and Analysis.	8
IV	**Software Reliability Modelling:** Introduction, Halstead's Software Metric, McCabe's Cyclomatic Complexity Metric, Error Seeding Models, Failure Rate Models, Curve Fitting Models, Reliability Growth Models, Non-Homogeneous Poisson Process Models, Markov Structure Models.	7
V	**NHPP Software Reliability Models:** Introduction, Parameter Estimation, NHPP Models, Applications, Imperfect Debugging Versus Perfect Debugging, A Generalized NHPP Software Reliability Model, Mean Time Between Failures for NHPP.	8
VI	**Software Cost Models:** Introduction, A Software Cost Model With Risk Factor, A Generalized Software Cost Model, A Cost Model With Multiple Failure Types, Applications.	7
VII	**Fault-Tolerant Software:** Introduction, Basic Fault-Tolerant Software Techniques, Self-Checking Duplex Scheme, Reliability Modeling, Reduction Of Common-Cause Failures.	7
VIII	**Software Reliability Models With Environment Factors:** Introduction, Definition Of Environmental Factors, Environmental Factors Analysis, A Generalized Model With Environmental Factors, Enhanced Proportional Hazard Jelinski-Moranda, An Application With Environmental Factors.	8

Suggested Readings:

1. K.Kapur, Software Reliability Springer Verlag, Singapore, 2008.
2. J.D. Musa, et. al. Software Reliability Measurement, Prediction and Application, McGraw Hill, New York, 1987.
3. J.D. Musa et. al. Software Reliability Engineering, TMH, New Delhi 2005.

The course can be opted as an elective by the students of following subjects:
B. Sc in Engineering, BCA, MCA, M.Sc.(IT)

Suggested Continuous Evaluation Methods: **Max. Marks: 25**

1. Assessment Type: Class Tests (Max. Marks 14)

Head
Department Of Computer Science
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Khandari Campus, Agra-282002

2. Assessment Type: Quizzes/ Objective Tests / Recognition Type (such as MCQs; True or False; Matching, Classifying) /Recall Type -Filling Blanks, One word / Phrase Answers (Max Marks: 5) 3. Assessment Type: Assignments (Max Marks: 4) 4. Assessment Type: Class Interaction (Max. marks: 2)
Course prerequisites: To study this course, a student must have had the subject Software Engineering, Software Project Management
Suggested equivalent online courses: 1. https://nptel.ac.in/courses/106/105/106105087/
Further Suggestions: None

Head
Department Of Computer Science
IET, Dr. Bhimrao Ambedkar University
Khandari Campus Agra-282002

Programme: M.Sc. (Computer Science)	Year: Fifth	Semester: X
Subject: Computer Science		
Course Code: B071010T	IoT	
Course Outcomes:		
Credits:	Core Compulsory	
Max Marks: 25+75	Min Passing Marks:	
Total No. of Lectures – Tutorial – Practical (in Hours per week): L-T-P: 4:0:0		

Unit	Topics	No. of Lectures
I	Introduction to Internet of Things: Introduction – Physical Design of IoT – Logical Design of IoT – IoT Enabling Technologies – IoT & Deployment Templates. Domain Specific IoTs: Introduction – Home Automation – Cities – Environment – Energy – Retail – Logistics – Agriculture – Industry – Health & Life style	08
II	IoT and M2M : Introduction: M2M – Difference between IoT and M2M – SDN and NFV for IoT. IoT System Management with NETCONF-YANG : Need for IoT Systems Management – Simple Network Management Protocol (SNMP) – Network Operator Requirements – NETCONF- YANG – IoT Systems Management with NETCONF YANG	08
III	IoT Platforms Design Methodology: Introduction – IoT Design Methodology – Case Study on IoT System for Weather Monitoring – Motivation for using Python. IoT Systems –Logical Design using Python: Introduction – Installing Python – Python Data types & Data Structures – Control Flow – Functions – Modules – Packages – File Handling – Date/Time Operations – Classes – Python packages of Interest for IoT.	08

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Department Of Computer Science
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Khandari Campus, Agra-282002

IV	**IoT Physical Devices & Endpoints:** What is an IoT Device – Exemplary Device: Raspberry Pi – About the Board – Linux on Raspberry Pi – Raspberry Pi Interfaces – Programming Raspberry Pi with Python – Other IoT devices, IoT Physical Servers & Cloud Offerings : Introduction to Cloud Storage Models & Communication APIs – WAMP - AutoBahn for IoT– Xively Cloud for IoT – Python Web application Framework- Django – Designing a REST ful 631 Web API – Amazon Web Services for IoT – SkynetIoT messaging platform.	08
V	**Case Studies Illustrating IoT Design:** Introduction – Home Automation – Cities – Environment – Agriculture – Productivity applications **Data Analytics for IoT** : Introduction – Apache Hadoop – Using Hadoop MapReduce for Batch Data Analysis – Apache Oozier – Apache Spark – Apache Storm – Using Apache Storm for Real-time Data Analysis.	08

This course can be opted as an elective by the students of following subjects:

B.Sc. in Electronics, B.Sc. in Physics, B.Sc. in Statistics, B.Sc. in Engineering, B.Sc. Vocational, BCA, Bachelor in Fine Arts., B.E./ B.Tech.

Suggested Continuous Evaluation Methods: **Max.Marks:25**
1. Assessment Type: Class Tests (Max. Marks14)
2. Assessment Type: Quizzes / Objective Tests/ Recognition Type (such as MCQs; True or False; Matching; Classifying) / Recall Type- Filling Blanks; One word / Phrase Answers (Max Marks:5)
3.Assessment Type: Assignments (Max Marks:4)
4.Assessment Type: Class Interaction (Max Marks:2)

Course prerequisites:
To study this course, a student must have had the subject Software Engineering

Suggested equivalent online courses

Further Suggestions:
None

Head
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Programme/Class: M.Sc. (Computer science)	Year: Fifth	Semester: Tenth
Subject: Computer Science		
Course Code: 8071015T	Course Title: Big Data & Data Analytics	

Course outcomes:

CO1: To identify Big Data and its business implications.
CO2: To access and process data on distributed file system
CO3: To manage job execution in Hadoop environment
CO4: To develop Big Data solutions using Hadoop

Credits: 4	Specialization Group B: Elective
Max. Marks: 25+75	Min. Passing Marks:

Total No. of Lectures-Tutorials-Practical (in hours per week): 4-0-0

Unit	Topic	No. of Lecture

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I	**Introduction:** Types of Digital Data, Introduction to Big Data, Big Data Analytics, Big Data Platform, Challenges of Conventional Systems, Intelligent data analysis, Nature of Data, Analytic Processes and Tools, Analysis vs Reporting.	7
II	**History of Hadoop,** Apache Hadoop, Analysing Data with Hadoop, Components of Hadoop Analysing the Data with Hadoop, Scaling Out, Hadoop Streaming, Hadoop environment, Hadoop Echo System.	8
III	**Hadoop Distributed File System:** Design of HDFS, HDFS Concepts, Command Line Interface, Hadoop file system interfaces, Data flow, Data Ingest with Flume, Sqoop, Hadoop archives, Hadoop I/O: Compression, Setialization, Avro, File based Data structures, Java Interfaces to HDFS.	7
IV	**Map Reduce Application:** Developing a Map Reduce Application, How Map Reduce Works, Anatomy of a Map Reduce Job run, Failures, Job Scheduling, Shuffle and Sort, Task execution, Map Reduce Types and Formats, Map Reduce Features.	8
V	**Pig:** Introduction to PIG, Execution Modes of Pig, Comparison of Pig with Databases, Grunt, Pig Latin, User Defined Functions, Data Processing operators, Filtering, Sorting, Combining and Splitting, Modes of execution.	8
VI	**Hive:** Hive Shell, Hive Services, Hive Metastore, Comparison with Traditional Databases, Data types, Create Database, Drop database, HiveQL, Tables, Create Tables, Alter Tables, Drop Tables, Partitioning, Querying Data, Operators, User Defined Functions.	7
VII	**Hbase:** HBasics, Concepts, Clients, Example, Hbase Versus RDBMS, Shell, General Commands, API, Tables and Operations, Create and Manage Data.	7
VIII	**Big SQL:** Introduction, Preparing Big SQL Environment, Creating Directories, Getting Sample Data, Create Tables, Loading Data, Creating SQL scripts, Running Sample Query, Analysis.	8

Suggested Readings:

1. Michael Berthold, David J. Hand, "Intelligent Data Analysis", Springer, 2007.

2. Tom White "Hadoop: The Definitive Guide" Third Edition, O'reilly Media, 2012.

3. Chris Eaton, Dirk DeRoos, Tom Deutsch, George Lapis, Paul Zikopoulos. "Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data", McGrawHill Publishing, 2012.

4. Anand Rajaraman and Jeffrey David Ullman, "Mining of Massive Datasets", CUP, 2012.

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5. Bill Franks, "Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics", John Wiley& sons, 2012.

6. Glenn J. Myatt, "Making Sense of Data", John Wiley & Sons, 2007.

7. Pete Warden, "Big Data Glossary", O'Reilly, 2011.

8. Jiawei Han, Michelline Kamber "Data Mining Concepts and Techniques", 2nd Edition, Elsevier, Reprinted 2008.

9. Da Ruan, Guoquing Chen, Etienne E.Kerre, Geert Wets, "Intelligent Data Mining", Springer, 2007.

10. Paul Zikopoulos, Dirkde Roos, Krishnan Parasuraman, Thomas Deutsch, James Giles , David Corrigan, "Harness the Power of Big Data The IBM Big Data Platform", Tata McGraw Hill Publications, 2012.

The course can be opted as an elective by the students of following subjects:
B. Sc.In Engineering, BCA, MCA, M.Sc.(IT)

Suggested Continuous Evaluation Methods: **Max. Marks: 25**

9. Assessment Type: Class Tests (Max. Marks 14)

10. Assessment Type: Quizzes/ Objective Tests / Recognition Type (such as MCQs; True or False; Matching; Classifying) /Recall Type -Filling Blanks; One word / Phrase Answers (Max Marks: 5)

11. Assessment Type: Assignments (Max Marks: 4)

12. Assessment Type: Class Interaction (Max. marks: 2)

Course prerequisites:
To study this course, a student must have had the subject Data Structures, Python programming

Suggested equivalent online courses:

Further Suggestions:
None

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Khandari Campus, Agra-282002

REVISED

COURSES AND SYLLABI

OF

M.Sc. ENVIRONMENTAL SCIENCE
FACULTY OF LIFE SCIENCE

(Based on Choice Based Credit System)

Under NEP-2020

2022

DEPARTMENT OF ENVIRONMENTAL STUDIES

SCHOOL OF LIFE SCIENCES

DR. BHIMRAO AMBEDKAR UNIVERSITY, AGRA

REVISED COURSES AND SYLLABI
OF
M.Sc. ENVIRONMENTAL SCIENCE
Faculty of Life Science
BASED ON CHOICE BASED CREDIT SYSTEM (CBCS)
Department of Environmental Studies,
Dr.BhimraoAmbedkar University, Agra
UNDER NEP-2020

Courses	**M. Sc. Environmental Science I semester**	**Marks**		**Total 100**	**Credit**
	Course Title	**CIE**	**End Semester Examination**		
EnvSc-C101	Ecology and Sustainable Development	25	75	100	4
EnvSc-C102	Environmental Pollution	25	75	100	4
EnvSc-C103	Energy and Environmental Policy	25	75	100	4
EnvSc-C104	Biodiversity and Conservation	25	75	100	4
EnvSc-C105	Practical		100	100	4
	Industrial training/Survey/Research Project				
	Total			**500**	**20**
Courses	**M. Sc. Environmental Science II semester**	**Marks**		**Total**	**Credit**
	Course Title	**CIE**	**End Semester Examination**		
EnvSc-C201	Environmental Chemistry	25	75	100	4
EnvSc-C202	Earth Processes and Soil Sciences	25	75	100	4
EnvSc-C203	Environmental Techniques	25	75	100	4
EnvSc-C204	Environmental Engineering	25	75	100	4
EnvSc-C205	Practical		100	100	4
EnvSc-C206	**Industrial training/Survey/Research Project**		200	**200**	**8**
	Minor (Other Faculty)	25	75	**100**	**4**
	Total			**800**	**32**
Courses	**M. Sc. Environmental Science III semester**	**Marks**		**Total**	**Credit**
	Course Title	**CIE**	**End Semester Examination**		
EnvSc-C301	Water resources and Marine Environment	25	75	100	4
EnvSc-C302	Solid and Hazardous Waste Management	25	75	100	4
EnvSc-C303	Environmental Bio-statistics and Modelling	25	75	100	4
EnvSc-E304	Meteorology: Tools And Techniques	25	75	100	4
EnvSc-E305	Atmosphere And Global Climate Change				
EnvSc-C306	Practical		100	100	4
	Industrial training/Survey/Research Project				
	Total			**500**	**20**
Courses	**M. Sc. Environmental Science IV semester**	**Marks**		**Total**	**Credit**
	Course Title	**CIE**	**End Semester Examination**		
EnvSc-C401	Environmental Impact and Risk Assessment	25	75	100	4
EnvSc-C402	Environmental Management and Laws	25	75	100	4
EnvSc–E403	Environmental Biotechnology	25	75	100	4
EnvSc–E404	Environmental Instrumentation				
EnvSc–E405	Ecotoxicology And Environmental Health	25	75	100	4
EnvSc–E406	Environmental Hazards				
EnvSc-C407	Practical		100	100	4
EnvSc-C408	**Industrial training/Survey/Research Project**		200	**200**	**8**
	Total			**700**	**28**
	Total Marks and Credits			**2500**	**100**

Course mapping to Global needs/Regional Needs/Local needs : Yellow color represents Global needs, Cyan color represents National needs Pink color represents Regional needs Orange Color represents Local needs Red color represent Employability CoursesGreen color represent Entrepreneurship CourseBlue color Skill Development Course

POST- GRADUATE PROGRAM OUTCOMES (POS)

The PG Courses of Environmental Science (Faculty of Life science) will be able:

PO 1	Demonstrate coherent understanding of fundamental concepts, principles and processes underlying the academic field of Environmental Science with its various subfields like Ecology, Biodiversity, Earth Sciences, Pollution and its Control Technology, Environmental Chemistry, Atmospheric Sciences, Environmental Laws, Environmental Impact Assessment, Environmental Biotechnology, Ecotoxicology, Waste Treatment Techniques, Renewable and Non-Renewable Energy, Environmental Statistics, Remote sensing and GIS, Climate Change and Sustainability, etc.
PO 2	Apply knowledge and skills to analyse, evaluate and interpret the causes and effects of various environmental problems at local, regional and global scale and to develop management strategies and use of different tools for the management of energy resources, biodiversity conservation, natural disasters and technical knowhow in environment management
PO 3	To understand the basic concepts of environment and its interactions with the earth and environmental systems and various ecosystems associated with it and obtain interdisciplinary knowledge on the global aspects of climate change, its effects on the environment and its governance.
PO 4	Ability to analyse and determine the magnitude of different kinds of environmental pollution, their sources using environmental analytical techniques, quantitative and computational techniques
PO 5	Capability to use biotechnological methods in water and wastewater treatment technology. Ability to apply appropriate techniques for efficient solid waste management practices and to find the solutions to the pollution problems.
PO 6	In depth knowledge of basic and applied area of Environmental Science will develop the capability of critical thinking based on the contextual knowledge of living and non-living components on environmental basis so as to enable the students to critically analyse everyday problems faced by society. Also enable student to use modern instrumentation techniques to employ critical thinking and efficient problem solving skills in the basic areas of Environmental Science
PO 7	Impart practical training, field's visits and project based training as well as specialization to the students for preparing them for an entrepreneurial thinking and career-oriented approach in research as well as in industries
PO 8	Students will keep themselves updated with the best international practices and latest development in technologies, which will help them to gain a broader global perspective of the subject. Develop awareness of the role and importance of Environmental Science in interdisciplinary research as well as in daily life.
PO 9	Students will be able to recognize the ethical component of complex situations. Acquired with awareness of work ethics and ethical issues in scientific research as well as plagiarism policies

Programme Specific Outcomes (PSOs)

PSO1	Programm provide wide range of knowledge on various aspects of various spheres of the environment viz atmosphere, hydrosphere, lithosphere and biosphere and generate awareness on Environmental Pollution, Solid Waste, toxicology, Climatic Change along with their inter- linkages to human health.
PSO2	To educate students on Environmental Impact Assessment, Monitoring, environmental laws and Policy frameworks their effectivity and their long-term outcome from environmental point of view.
PSO3	Get practical knowledge about various physico-chemical parameters, air monitoring and removal/reduction of air, soil and water pollutants from the environment through different analytical techniques and minimization of waste by waste recycling and reuse. Course also provides knowledge on concepts, tools, modern techniques and instruments for analysis of various components of environment and their management.
PSO4	Programm include training for capacity building, to offer professional and job oriented course curricula, to strengthen research & development and extension activities.
PSO5	To Understand the importance and contribute to Environmental Sustainability and wise use of Natural Resources for benefit of society through education and research on environment with a multidisciplinary and professional approach.

Yellow color represents Global needs, **Cyan color represents National needs**

Pink color represents Regional needs **Orange Color represents Local needs**

Red color represent Employability Course **Green color represent Entrepreneurship Course**

Blue color Skill Development Course

FIRST SEMESTER

Core Course

Code-EnvSc-C101

ECOLOGY AND SUSTAINABLE DEVELOPMENT

Course Description The course provides an introduction into the basics of Ecology. The concepts of the different processes of ecosystem, population ecology and the interaction of different ecological factors with biotic components are laid out.

Topics	Teaching Hours
UNIT-I	
1) Definition, principles and scope of ecology, Human ecology and settlement. 2) Population, Community, biome, limiting factor. 3) Characters of community and concept of habitat. 4) Functional role of ecology and niche, keystone species, ecotone and edge effect.	15
UNIT-II	
1) Population dynamics, model for single and interacting population. 2) Stable points, cycles, chaos competition. 3) Ecological succession, Climax community and their models. 4) Parasitism and prey-predation	15
UNIT-III	
1) Concept of ecosystem: abiotic and biotic concept. 2) Concept of energy, food chain, food web and ecological pyramids. 3) Pattern of primary and secondary production in major ecosystems of world, feedback and control. 4) Ten percent law, Gross and net production.	15
UNIT-IV	
1) The concept of sustainable development, temporal and spatial dimensions. 2) Public participation, education and environmental decision making. 3) Concept of reuse, reduce and recycle (6R) of different type of wastes, Environmental degradation and conservation issues. 4) Ecosystem as social process in Rehabilitation of degraded rural landscape, unbalanced soils and habitats e.g. water bodies and mangroves. Rehabilitation of mined area.	15

Suggested Readings: Clapham Jr., W.B., 1983, Natural Ecosystem: Chapters I, II, III and IV. Macmillan Publishers, London

GadgilMadhav, 2004, Ecological Journeys. The Science and Politics of conservation in India, Permanent black, Delhi.

Heywood, V.H. (Executive Editor), 1995, Global Biodiversity Assessment: Chapters 5 and 6. UNEP, University Press, Cambridge

Jennifer, A., Burch. W.R., Conover, B. and Field, D., 1998. Ecosystem Management: Adaptive strategies for Natural Resources organizations in the 21 st Century. Taylor and Francis, London. Reid, W.V. et al (Ed.), 2005, Ecosystems and Human well-being: Synthesis. P.1-37. Millennium Ecosystem Assessment, World Resource Institute, Island Press, Washington DC.

Samson, B.F, and Knoff, F.L., 1996, Ecosystem Management. Springer-Verlag, New York.

Course Outcome:-

CO1: Students will be well versed with the fundamentals of Ecology.

CO2: Students will have knowledge about population dynamics and the concept of ecological succession.

CO3: Students will have in-depth knowledge about biotic and abiotic factors that are related to ecosystem, productivity, energy flow through natural food webs, and ecosystems dynamics.

CO4: Students will have knowledge about participation of public in environmental management, Concept of 6R and environmental degradation and conservation.

Course Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	3	1	1	-	-	2	-	2	2	3	-	-	-	-
CO2	3	2	3	-	-	-	-	1	-	1	-	-	-	-
CO3	2	1	3	1	-	-	-	1	-	3	-	-	-	2
CO4	1	3	2	3	2	-	-	2	1	2	1	2	-	3

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

Employability and Entrepreneurship Course

FIRST SEMESTER

Core Course

Code-EnvSc-C102

ENVIRONMENTAL POLLUTION

Course Description: This course have been designed to improve the familiarity of the students about different pollution problems in environmental compartments i.e. air, water, noise and soil and their impact on environment and health are dealt with.

Topics	Teaching Hours
UNIT-I	
1) Chemistry of water-Types, sources and consequences of water pollution. 2) Types and characteristics of domestic, industrial and agricultural wastes and their effects on water bodies, animal and human beings. 3) Water quality parameters, Physiochemical and bacteriological sampling. 4) Water quality standards (Drinking Water).	15
UNIT-II	
1) Atmosphere and its fraction; gas laws governing the behavior of pollutants in atmosphere. 2) Natural and Anthropogenic sources of atmospheric pollutants, their effects on animal, human, vegetation and materials and their reaction in the atmosphere. 3) Transport and dispersal of pollutants, effects of meteorological and topographical factors. 4) Sampling of gaseous and particulate matter, their analysis and air quality standards.	15
UNIT-III	
1) Basic properties of sound waves plane and spherical waves, sound pressure and intensity levels, decibel, effects of meteorological parameters on sound propagation measurement and analysis of sound. 2) A weighted sound level, equivalent sound level (leq.) Noise pollution level (NPL), Sound exposure level (SEL), Traffic sound index (TNI), Day night level. 3) Source of noise, noise control and abatement measures, and sound absorption coefficient. 4) Hazards of noise pollution, effects on physiological, circulatory, respiratory, muscular, hearing loss and threshold shifts and noise standards.	15
UNIT-IV	
1) Physico-chemical and bacteriological sampling as analysis of soil quality. 2) Sources of soil pollution, Industrial waste effluents and heavy metals, their interactions with soil components. 3) Soil micro-organisms and their function, degradation of different insecticides/fungicides and weedicides in soil. 4) Different kind of synthetic fertilizers (NP & K) and their interactions with different components of soil.	15

Suggested Readings: Leslie collier, Balows Albert and Sussman Max, Topley and Wilson's Microbiology and Microbial infections. Oxford University Press.

Murray J.F. and Nadel. J.A., 2000, Text book of respiratory medicine, 3 rdEdn.,

W.B. Saunders & Co. Park. J.E. and Park. K., 1994, Text book of preventive and social medicine,

Banarsi Das &Bhanot, Jabalpur.

A.C. Stern, Air Pollution vol. 1 – 7.

Anjaneyulu. Y, 2004, Introduction to Environmental Science. B. S. Publications.

D. Daniel Chiras, 2001, Environmental Science, 6 th Ed., Jones and Bartlett Publishers.

Course Outcome:-

CO1: Develop understanding about the various sources, and fate of different water pollutants with their effects on environment and human.

CO2: Develop understanding on atmosphere fraction, air pollution its sources and its effect on environment and human and transport and dispersal of air pollutant.

CO3: Students are expected to be able to analyze noise pollution and different index of noise and health effect of noise pollution.

CO4: Develop understanding to determine soil pollution and degradation of pesticides in soils and physicochemical and bacteriological sampling of soil.

Course Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	3	2	-	2	2	2	3	2	1	3	2	3	2	3
CO2	2	3	2	3	1	2	3	2	-	3	2	3	3	2
CO3	2	1	-	2	-	1	-	1	-	2	1	-	-	1
CO4	2	2	-	2	-	1	1	2	1	3	1	3	3	2

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

Skill Development Course

FIRST SEMESTER
Core Course
Code-EnvSc-C103
ENERGY AND ENVIRONMENTAL POLICY

Course Description: The objective of the curriculum is to make the student to understand about different energy forms, importance of renewable and non-renewable energy sources and its consumption pattern in the world and India. It also enables students to learn about principle, generation and applications of different forms of energy and their respective managerial aspects.

Topics	Teaching Hours
UNIT-I	
1) Sun as source of energy: Earth and Sun relationship, nature and its radiation and heat budget of earth. 2) Conventional and non-conventional energy resources: Fossil fuel, coal, oil and natural gas, hydroelectric power, tidal, wind and geothermal energy. 3) Biomass, solar collectors, photovoltaic and solar ponds. 4) Natural energy resources: soil, water, land wood etc.	15
UNIT-II	
1) Resources of energy and their impacts on environment. 2) Minerals Resources-Types, their characteristics and uses. 3) Nature of nuclear energy, history of nuclear energy development, Nuclear Reactors 4) Nuclear Fusion, Breeder Reactors, Nuclear Fission, Nuclear Fuel Cycle.	15
UNIT-III	
1) Energy consumption criteria in different parts of world and conservation of energy. 2) Concept of environmental ethics. 3) Energy and Sustainable development of environment, 4] Strategic analysis of India-multi-dimensional energy crisis.	15
UNIT-IV	
1) Agenda-21 and government policy for natural resources and environment. 2) Land use policy for India, urban planning for India. 3) Environmental education and awareness: formal and non-formal education. 4) Role of UNESCO and Non-governmental organizations in environmental conservation.	15

Suggested Readings: Craig. J.R., Vaughan. D.J., Skinner. B.J., 1996, Resources of the Earth: origin, use, and environmental impact, 2 nd Ed. Prentice Hall, New Jersey. Klee. G.A, 1991, Conservation of natural resources.. Prentice Hall Publ. Co., New Jersey.

Owen. O.S, Chiras. D.D, Reganold. J.P, 1998, Natural resource conservation – management for sustainable future, 7 th Ed., Prentice Hall.

Course Outcome:-

CO1: To learn to apply various technologies for generation of renewable energy from different environmental sources.

CO2: Ability to estimate the extent of pollution due to energy use and about nuclear energy resources.

CO3: Studentswill be able to demonstrate understanding of the global, regional and local initiatives for energy conservation and sustainable development and learn about the different ways to classify energy resources, their consumption pattern.

CO4: Students will be able to understand the role of different agency in the conservation of environment and knowledge about land use policy.

Course Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	3	3	1	-	3	2	3	1	2	3	1	2	2	1
CO2	3	3	2	3	2	2	3	2	1	3	2	3	1	-
CO3	3	2	3	2	1	2	1	3	2	3	2	3	2	3
CO4	3	3	2	1	1	2	2	3	2	3	-	1	-	1

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

Employability Course

FIRST SEMESTER
Core Course
Code-EnvSc-C104
BIODIVERSITY AND CONSERVATION

Course Description: To impart understanding on the occurrence and distribution of various flora and fauna, their existence, interaction, Importance of biodiversity conservation and understand about Legislation related to conservation.

Topics	Teaching Hours
UNIT-I	
1) Concept: organic evolution through geological time scales. 2) Introduction to biodiversity and its types. 3) Levels and gradients of biodiversity. 4) Ecosystem biodiversity – Biomes, Mangroves, coral reefs, wetlands.	15
UNIT-II	
1) Terrestrial diversity. 2) Threats to biodiversity: Disturbance and pollution, Introduction of exotic species, Extinction of species. 3) Human interventions and biodiversity loss: Global environmental change, land and water use changes. 4) RED data book and related documentations.	15
UNIT-III	
1) Methods of biodiversity conservation – In situ conservation (Biosphere Reserve, National Parks, Wildlife Sanctuaries, Scared Groves). 2) Ex situ conservation (Botanical garden, Zoological garden, Gene Bank, pollen, seed and seedling banks tissue culture and DNA bank. 3) IUCN categorized – endangered, threatened, vulnerable species. 4) International organization related to biodiversity conservation (Traffic, REED, REED +).	15
UNIT-IV	
1) Benefits of conservation. 2) Conservation projects. 3) History of conservation movements. 4) Biodiversity Hotspots and its criteria.	15

Suggested Readings: Daily, G.C., Ed., 1997, Nature's Services: Societal Dependence on Natural Ecosystems. Island Press, Washington, D.C.

Dobson, A.P., 1996, Conservation and Biodiversity. Scientific American Library, New York, NY.

Gaston, K J. and J.I. Spicer, 1998, Biodiversity: An Introduction. Blackwell Science, London, UK.

Groom bridge, B., and M. Jenkins, 2000, Global Biodiversity: Earth's Living Resources in the 21 st Century. World Conservation Press, Cambridge, UK.

IUCN, 2004, Red list of threatened species. A global species assessment. IUCN, Gland, Switzerland

Loreau, M., and P. Inchausti, 2002, Biodiversity and Ecosystem functioning: Synthesis and Perspectives. Oxford University Press, Oxford, UK.

Primack, R.B., 2002, Essentials of Conservation Biology, 3 rdEdn.,Sinauer Associates, Sunderland, Ma. USA

Wilson, Edward O., 1993, Diversity of Life. Harvard University Press, Cambridge, MA.

Course Outcome:-

CO1: Students will gain knowledge about the diversity distribution pattern of the enormous number of species and different kind of ecosystems in the world.

CO2: Students will gain knowledge about threat to biodiversity and the loss of biodiversity and the impact to the humankind.

CO3: Students will know about the importance of conservation of biodiversity which serving to the mankind and the ecosystem, and the international organization related to biodiversity conservation.

CO4: Students will learn the benefits of conservation project and history of different conservation movements.

Course Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	**2**	**3**	**2**	**2**	**3**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**2**	**1**
CO2	**3**	**3**	**2**	**3**	**2**	**2**	**3**	**2**	**1**	**3**	**2**	**3**	**1**	**-**
CO3	**1**	**1**	**1**	**2**	**1**	**2**	**1**	**3**	**2**	**3**	**2**	**3**	**2**	**3**
CO4	**2**	**2**	**-**	**1**	**1**	**2**	**2**	**3**	**2**	**3**	**-**	**1**	**-**	**1**

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

Skill Development, Employability and Entrepreneurship Course

FIRST SEMESTER

Core Course

Code - EnvSc-C105

Practical

Course Description

The course provides practical exposure to the different biotic and abiotic components of the ecosystem and their analysis.

Course Structure

The following is a detailed syllabus.

1. To determine the minimum size of quadrate by species area curve method.
2. To determine the frequency of plants species present in given area.
3. To determine density of plant species present in the given area by quadrate method.
4. To determine the abundance of plant species in the given area by the quadrate method.
5. To determine the total biomass production in a grassland.
6. To determine acidity of given water sample.
7. To determine alkalinity of given water sample.
8. To determine chloride of given water sample.
9. To determine free CO_2 of given water sample.
10. To determine TS of given water sample.
11. To determine TDS of given water sample.
12. To determine TSS of given water sample.
13. To determine hardness of given water sample.
14. To determine Ca hardness of given water sample.
15. To determine Mg hardness of given water sample.
16. Measurement of noise level in different environments by sound level meter (SLM).
17. To estimate the value of background noise (L90) at a traffic site.
18. To estimate the value of L 50 at a traffic site.
19. To estimate the value of L10 at a traffic site.
20. What is the sound pressure level in dB associated with root mean square?

Suggested Readings: Environmental Biology - Mike Calver, Alan Lymbery, Jennifer McComb and Mike Bamford, Elements of Environmental Chemistry – J. Hussain, APHA, AWWA, WEF (1998). Standard Methods of water and waste water. APHA (20th Edition

Course Outcome

By the end of the course, students are expected to be able to:

- Gain practical knowledge into analysing the effects of ecological factors
- Have practical knowledge of the abiotic-biotic and biotic-biotic interactions

Course Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	3	2	3	-	-	2	3	2	2	1	-	1	3	-
CO2	2	2	3	-	-	3	3	2	2	1	-	1	3	-

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

Skill Development Course

SECOND SEMESTER

Core Course

Code-EnvSc-C201

ENVIRONMENTAL CHEMISTRY

Course Description: The objective of the curriculum is to acquaint the student about the chemical composition of the different components of the environment (air, water, soil) and their subsequent interaction with biotic and abiotic components.

Topics	Teaching Hours
UNIT-I	
1) Fundamentals of Environmental Chemistry: Stoichiometry, Gibb's energy, chemical potential, chemical equilibria. 2) Acid base reactions, solubility product, solubility of gases in water. 3) The carbonate system, unsaturated and saturated hydrocarbons, radionuclide's. 4) Energy fundamentals: First and Second law of Thermodynamics.	15
UNIT-II	
1) Chemical composition of air: Classification of elements, chemical speciation, particles, ions and radicals in the atmosphere. 2) Chemical processes for formation of inorganic and organic particulate matter, photochemical reactions in the atmosphere. 3) Oxygen and ozone chemistry: Ozone production, ozone destruction and its effects. 4) Photochemical smog, formation of peroxyacetyl nitrates (PAN) and its effects.	15
UNIT-III	
1) Water chemistry: Chemistry of water, concept of DO, BOD, COD, sedimentation, coagulation, filtration, redox potential. 2) Soil chemistry: Inorganic and organic components of soil, Nitrogen pathways and NPK in soils. 3) Elemental Cycles and their environmental significance (nitrogen cycle, Sulphur cycle, carbon cycle and oxygen cycle) 4) Acid rain: Formation of acid rain and its effects on artifacts, Toxic chemicals in the environment- (water) : Pesticides in water, biochemical aspects of arsenic, cadmium, lead, mercury,	15
UNIT-IV	
1) Toxic chemicals in the environment- (Air): carbon monoxide, ozone, pesticides, insecticides, MIC in the air. 2) Greenhouse gases and their effects, Global warming, Causes andConsequences of Global Climate Change. Role of ocean and forest as carbon sink. 3) Indoor air pollution: indoor/outdoor relationships, personal air pollution exposure, indoor air quality problems, Prevention and control measures. 4) Vehicular Pollution: Automobile emissions, effects, prevention and control of Vehicular pollution, brief description of Euro I, Euro II, Euro III & Euro IV norms for automobiles and urban air quality.	15

Suggested Readings: Manahan. Stanely E, 2000, 7 thEdn., Environmental Chemistry, Lewis Publishers.
Stumm, W.; Morgan, J. J., 1996, Aquatic Chemistry: Chemical Equilibria and Rates in Natural Waters; Wiley Interscience: New York,.
Wayne, R. P., 2000, Chemistry of Atmospheres: An Introduction to the Chemistry of the Atmospheres of Earth, the Planets, and their Satellites (3rd Ed.), Oxford University Press
Williams Ian, 2001, Environmental Chemistry –a modular approach, Willey John & Sons
Williams. R.J.P and Frausto da. J.J.R, 1996, The Natural Selection of the Chemical Elements, Oxford University Press, Oxford, UK /New York, NY
Willard & Others, 1988, Instrumental Methods of Analysis, Wadsworth.

Course Outcome:-

CO1: Able to analyze& apply the concept of thermodynamics, laws and heat transformation processes in different spheres of environment.

CO2: Able to explain the chemical nature and interaction of the air and its characteristic features for survival growth of biota.

CO3: Trains on chemical analysis of water and waste water, and the scientific principle of tools and techniques used for chemical analysis.s

CO4: Student will have the ability to understand about Global climate change & its impact of different component of environment.

Course Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	**3**	**2**	**-**	**1**	**1**	**2**	**1**	**1**	**1**	**2**	**1**	**2**	**1**	**-**
CO2	**3**	**2**	**3**	**3**	**2**	**1**	**-**	**2**	**2**	**3**	**1**	**2**	**1**	**2**
CO3	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**3**	**2**	**3**	**3**	**3**	**2**	**2**
CO4	**3**	**3**	**3**	**3**	**2**	**2**	**1**	**2**	**2**	**3**	**1**	**2**	**1**	**3**

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

SECOND SEMESTER
Core Course
Code-EnvSc-C202
EARTH PROCESSES AND SOIL SCIENCES

Course Description: The objective of the curriculum is to impart the knowledge on earth processes which are related with weather and climate, soil characteristics and about various natural hazards.

Topics	Teaching Hours
UNIT-I	
1) Primary formation of core, mantle and crust. 2) Magma generation, Formation of igneous rock and sedimentary rock. 3) Glaciers and glaciations: Types of glaciers, surface profile of glaciers, Glaciers and glaciations: Types of glaciers, surface profile of glaciers. 4) Weathering of rocks, Erosion, transportation and deposition of earth's materials by running water, wind and glaciers	15
UNIT-II	
1) Concept of Geological hazards. 2) Study of Floods, landslides, earthquake, volcanism, drought and cyclones. 3) Prediction and perception of hazards and disaster management. 4) Sea floor spreading and mountain building, rock deformation, evolution of continents.	15
UNIT-III	
1) Soil genesis: formation and soil profile development. 2) Classification of soil, chemical and mineralogical composition of soil. 3) Soil organic matter and their sources, composition, microbial decomposition of organic matter. 4) Humus formation: nature and properties of humus, clay-humus complex and significance.	15
UNIT-IV	
1) Soil colloidal system, soil acidity and alkalinity salinity, nature, formation and control. 2) Major soil nutrients and elements, hygroscopic nature of soil, capillary and gravitational forms of soil water. 3) Soil air composition and gaseous exchange between atmosphere and soil air. 4) Soil temperature and loss of heat and thermal conductivity.	15

Suggested Readings: Keller. Edward A, 1996, Introduction to Environmental Geology, Prentice Hall, Upper Saddle River, New Jersey

Kesler, S. F. 1994, Mineral resources, economics and the environment. Upper Saddle River, NJ: Prentice Hall.

Owen., Oliver S, Chiras. Daniel D, Reganold. John P., 2002, Natural Resource Conservation, 7th Ed., Prentice Hall, Upper Saddle River, New Jersey

Skinner, Brian J., Porter, Stephen C., 1995, The Dynamic Earth: An Introduction to Physical Geology, Casebook, 3rd Edition (Paperback), John Wiley, New York

Skinner, B. J., and Porter, S. C., 1995, The Blue Planet, An Introduction to Earth System Science, John Wiley & Sons, Inc.

Slaymake, Olav, (Editor), 2000, Geomorphology, Human Activity and Global Environmental Change. John Wiley, New York.

Course Outcome:-

CO1: Have sound knowledge on the earth's structure,Understanding the Earth system of interacting rock, water, air and life and how these elements have shaped Earth's surface.

CO2: Will be able to understand and differentiate the different types of disasters, analyse the causes and their potential impact on the natural and man-made environments.

CO3: Ability to demonstrate the understanding of the core principles of soil science.

CO4: Ability to describe the process of soil genesis and identify soil orders/groups based on their physico-chemical properties

Course Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	3	3	3	2	-	2	-	2	2	3	1	2	1	3
CO2	3	3	3	3	3	2	2	3	3	3	3	3	2	3
CO3	3	2	3	2	1	2	2	2	2	3	2	2	1	2
CO4	2	1	2	1	2	2	-	1	1	2	1	2	-	2

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

Skill Development, Employability and Entrepreneurship Course

SECOND SEMESTER

Core Course

Code-EnvSc-C203

ENVIRONMENTAL TECHNIQUES

Course Description: The objective of the curriculum is to impart the knowledge about the different analytical technique to measure air and water pollution and to gain understanding about various methods of exposure of toxicants

Topics	Teaching Hours
UNIT-I	
Air Quality Monitoring and Sampling Methods 1) Sulphur di Oxide 2) Oxide of Nitrogen 3) Suspended Particulate Matter 4) RSPM - PM10 and PM2.5	15
UNIT-II	
Water Quality Sampling and Analysis Methods 1) Turbidity, Total Solids 2) DO, BOD,COD 3) Sodium, Potassium, 4) Arsenic, Cadmium, 5) Zinc ,Chromium, 6) Copper, Iron. 7) Biological Analysis: Qualitative and quantitative methods for planktons, MPN in coliforms.	15
UNIT-III	
Biochemical Methods 1) Serum Total Protein, Serum Albumin, 2) Serum Globulin, Albumin-Globulin Ratio, 3) Cholesterol, HDL-Cholesterol, 4) Alkaline Phosphatase, 5) Acid Phosphatase, 6) SGPT, SGOT.	15
UNIT-IV	
Methods of Exposure of Toxicants 1) Dose-Response and Dose-Effect Relationship; 2) Statistical Concept of LC50AndLD50; 3) Bioassays.	15

Suggested Readings: American Public Health Association (APHA), 1998 Standard Methods for the Examination of water and waste water 20th edition

Thimmaiah, S.K., 1999 Standard Methods of Biochemical Analysis,Kalyani Publisher

Abbasi S.A. 1998 Water Quality Sampling and Analysis, Discovery Publishing House, New Delhi

Course Outcome:-

CO1: Evaluate the level of pollutants in soil, water, air and organisms by using analytical instruments.

CO2: Will be able to understand different methods for water quality parameter sampling.

CO3: Student will be able to learn and analyze about different biochemical methods for serum testing.

CO4: Students will be able to evaluate toxicants by different methods of toxicants exposure

Course Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	2	3	2	2	3	2	3	1	2	3	1	2	2	1
CO2	3	3	2	3	2	2	3	2	1	3	2	3	1	-
CO3	1	1	1	2	1	2	1	3	2	3	2	3	2	3
CO4	2	2	-	1	1	2	2	3	2	3	-	1	-	1

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

Employability and Entrepreneurship Course

SECOND SEMESTER

Core Course

Code-EnvSc-C204

ENVIRONMENTAL ENGINNERING

Course Description: The main objectives of this course are to educate the students about the designing of primary, secondary and tertiary treatment systems of waste water and to gain knowledge about air pollution abatement and control methods and about different waste treatment and disposal technique.

Topics	Teaching Hours
UNIT-I	
1) Elimination and minimization of air pollution emission. 2) Selection criteria of a control system. 3) Air pollution Control Equipment's: Cyclone Collector, Filtration and Electrostatic Precipitators. 4) Air pollution Control Equipment's: Scrubbing, Adsorption.	15
UNIT-II	
1) Waste water treatment by aeration, coagulation and flocculation, sedimentation and filtration. 2) Aerobic and anaerobic process of waste water treatment. 3) Waste water treatment process – Primary, Secondary and Tertiary treatment. 4) Sludge treatment and disposal.	15
UNIT-III	
1) Solid waste collection and transportation. 2) Solid waste processing and recovery. 3) Disposal Technique – Landfilling method, its basic aspect and types and Incineration. 4) Energy recovery methods of solid waste disposal: Gasification, Pyrolysis, Plasma pyrolysis.	15
UNIT-IV	
1) Hazardous waste treatment strategies. 2) Treatment of biomedical waste by incineration, Microwave, Autoclave, Hydroclave. 3) Disposal of plastic waste and treatment and disposal of metal sharps. 4) Nuclear waste disposal technique.	15

Suggested Readings: Henry Glya, J. and Heinke, 2004, Gary W. Environmental Science and Engineering. Pearson low priced edition.

Kiely, G., 1998, Environmental Engineering, Irwin McGraw Hill, Boston.

Masters, M.G., 1998, 2nd Edition, Introduction to Environmental Engineering and Science, Prentice Hall, London.

Peavy, H.S., Rowe, D.R. and George, T., 1987, Environmental Engineering, McGraw Hill, New York.

Vesilind, P.A., 1997, Introduction to Environmental Engineering. PWS publishing, Boston

Course Outcome:-

CO1: Gain knowledge about environment air protection and operation of pollution control devices**.**

CO2: Student will understand the engineering concepts of waste water treatment and will know the different analytical methods of waste water treatment and disinfection methods

CO3: Gain knowledge about different method for solid waste disposal and various energy recovery method of waste disposal

CO4: Students will be able to gain understanding about biomedical waste and plastic waste disposal methods.

Course Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	3	3	2	3	3	3	3	3	3	3	2	3	1	2
CO2	3	3	2	3	3	2	3	3	3	3	1	3	-	1
CO3	3	2	2	3	2	3	2	3	3	3	2	3	-	-
CO4	3	3	3	3	2	-	1	1	-	3	1	3	-	-

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

Skill Development, Employability and Entrepreneurship Course

SECOND SEMESTER

Core Course

Code – EnvSc-C205

Practical

Course Description

The course provides practical exposure to the soil component and their analysis and also provides practical knowledge about the analysis of oxygen demand of water by different method.

Course Structure: The following is a detailed syllabus.

1. To determine the water holding capacity in a given soil sample.
2. To determine the alkalinity in a given soil sample.
3. To determine the chloride ions in a given soil sample.
4. To determine the amount of organic carbon in a given soil sample.
5. To determine the amount of organic matter in a given soil sample.
6. To determine the amount of the humus content in a given soil sample.
7. To determine the amount of exchangeable calcium in the given soil sample.
8. To determine the amount of exchangeable magnesium in the given soil sample.
9. Determination of sodium ion concentration by Flame photometer in waste water.
10. Determination of potassium ion concentration by Flame photometer in waste water.
11. To determine the dissolve oxygen in a given water sample.
12. To determine the biological oxygen demand in a given water sample.
13. To determine the chemical oxygen demand in a given water sample.
14. To determine the oil and grease in a given water sample.
15. Determination of SO2 by PRA method.
16. Determination NOx by spectrophotometric method.
17. Measurement of noise level in different environments by sound level meter (SLM).
18. Determination of particulate matters PM10 and PM2.5 by Fine Particulate sampler.
19. Respirable Suspended Particulate Matter (RSPM) by Respirable suspended particulate matter sampler (RDS APM 460)

Suggested Readings: APHA, AWWA, WEF (1998). Standard Methods of water and waste water. APHA (20th Edition, PatnaikP(1997). Handbook of Environmental Analysis- Lewis Pub, Environment and Water Pollution cause Effect and Control- Noor

Course Outcome

By the end of the course, students are expected to be able to:

CO1: Gain practical knowledge about the analysis of different parameter of soil.

CO2: Have practical knowledge of methods for analyzing COD, BOD and DO in waste water and analysis of different air pollutant.

Course Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	1	1	-	3	2	3	3	1	2	2	-	3	3	-
CO2	2	-	-	3	-	3	3	2	2	2	-	3	3	-

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

THIRD SEMESTER
Core Course
Code-EnvSc-C301
WATER RESOURCES AND MARINE ENVIRONMENT

Course Description: The main objectives of this course are to educate the students about the ground water, its type and give in dpeth knowledge about well hydraulic. Student will be able to understand concept of the study of oceans, its chemical properties and geological & geophysical oceanography.

Topics	Teaching Hours
UNIT-I	
1) Ground Water: Origin, types, importance, occurrence, reservoirs, basins and movement. Hydrologic cycle and its balance. 2) Hydrologic properties of rocks: porosity, permeability, specific yield, specific retention, hydraulic conductivity, transmissivity, storage coefficient. 3) Darcy's law and experiment. 4) Well hydraulics: Confined, semi-confined and unconfined aquifer. Time variations of levels, fluctuations due to evapotranspiration, urbanization, Meteorological phenomena and land subsidence. 5) Ground water quality, measurement of water quality, Ground water contamination and pollutants: Problem of arsenic and fluoride.	15
UNIT-II	
1) Surface water; Atmospheric aspects of the hydrologic cycle: weather and climate, evaporation, evaporation and transpiration, Evapotranspiration. 2) Precipitation and run off: Conditions for precipitation occurrence, forms of precipitation, average basin precipitation, rainfall and run off. 3) Stream flow: Measurement of stream flow, Interaction of surface water and ground water. 4) Rainwater harvesting, eutrophication restoration of Indian lakes and wetland conservation,National Water policy	15
UNIT-III	
1) Origin and composition of sea water. 2) Physical properties of marine water: temperature, density, optics, currents, wave generation, thermo-hyaline turbidity currents (gravity), gyres. 3) Chemical properties of marine water: Salinity and its determination and distribution, causes of salinity variations. 4) Dissolved gases and carbonate chemistry of ocean water, residence time, biochemical reactions and their distributions.	15
UNIT-IV	
1) Biological Oceanography: Division of the marine environment benthic, pelagic, bathyal, littoral, ocean water as biological environment. 2) Ocean pollution by toxic wastes and its effect. 3) Geological and Geophysical Oceanography: History of ocean basin, geophysical and geological processes, ocean basin rocks and sediments. 4) Beach and beach processes, littoral sediment transport, coastal erosion- causes and protection, resources of ocean, renewable and non-renewable.	15

Suggested Readings: Aggarwal, A., 1991, Floods, Floodplains and Environmental Myths. Centre for Science and Environment, New Delhi.
Andrew D. Ward and Stanley Trimble, 2004, 2 nd Ed., Environmental Hydrology, Lewis Publishers.
Karanth, K.R.C., 1988, Ground Water: Exploration, Assessment and Development. Tata-Mcgraw Hill, New Delhi.
Mahajan, G., 1989, Evaluation and Development of Groundwater. Ashish Publishing House, New Delhi.
Rao, K.L., 1982, India's water wealth. Orient Longman, Delhi.
Subramaniam V., 2002, Text Book of Environmental Science, Narosa Publishing House, Delhi.
Timothy, Davie, 2003, Fundamentals of Hydrology. Rowledge, Taylor and Francis Group, U.K.
Todd, D.K., 2004, Groundwater Hydrology, John Wiley & Sons Inc.
Vijay P. Singh, 1995, Environmental Hydrology. Kluwer Academic Publications, The Netherlands.
Wright. R.T and Nebel. B.J., 2002, Environmental Science: toward a sustainable future, Prentice Hall India Ltd, 8 th Edition.

Course Outcome:-

CO1: Gain knowledge about types and origin of ground water, different hydrological properties of rocks and well hydraulics

CO2: Student will be able to understand atmospheric aspects of the hydrologic cycle, rainwaterharvesting, eutrophication and wetland conservation,

CO3: Will be able to understand Origin and composition of marine water and its physico-chemical properties.

CO4:.Able to understand biological Oceanography and will have depth knowledge about history and origin ofocean .

Course Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	2	-	1	3	2	2	2	1	-	3	-	3	-	2
CO2	2	-	2	-	-	1	1	-	-	2	-	-	-	2
CO3	3	-	1	-	-	-	-	1	1	-	-	-	-	1
CO4	2	2	-	2	-	-	1	1	1	3	-	2	1	1

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

Employability Course

THIRD SEMESTER

Core Course

Code-EnvSc-C302

SOLID AND HAZARDOUS WASTE MANAGEMENT

Course Description: objective of this course is to develop an understanding of management generation treatment and disposal different type of waste viz., hazardous, solid, bio medical and radioactive waste.

Topics	Teaching Hours
UNIT-I	
1) Definition and Classification Hazardous waste, ignitability, corrosivity, reactivity, toxicity, radioactivity. 2) Hazardous waste: Sources, effects, storage and handling. 3) Management of Hazardous wastes: Pollution, prevention, waste minimization, recycling of wastes, land disposal. 4) Risk assessment: Carcinogens, dose response assessment, risk exposure assessment.	15
UNIT-II	
1) Radioactive pollution, biological effects of ionizing radiation. 2) Radiation exposure, radiation protection, radioactive waste. 3) E- Waste&it's effect and Plastic waste and It's effect. 4) Fly ash and its utilization.	15
UNIT-III	
1) Solid Waste : Definition, Source and types 2) Generation and Effects of solid waste. 3) Physical and chemical composition of solid waste. 4) General characterization and classification of solid waste	15
UNIT-IV	
1) Different methods of solid waste management. 2) Recycling of solid waste material. 3) Environmental concern of landfilling of municipal solid waste. 4) Biomedical Waste: Definition, Sources of generation, categories, colour coding system for segregation, transportation specifications.	15

Suggested Readings:

Henry Glya, J. and Heinke, 2004, Gary W. Environmental Science and Engineering. Pearson low priced edition.
Kiely, G., 1998, Environmental Engineering, Irwin McGraw Hill, Boston.

Course Outcome:-

CO1: Students will be able to understand about the characteristics of different type of hazardous waste and their treatment and management

CO2: Gain knowledge about the generation and type and disposal of radioactive waste

CO3: Ability to demonstrate sound understanding of the waste generation process and characteristics of different types of solid wastes.

CO4:. Ability to address the waste management processes through cradle-to-grave perspectives.

Course Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	2	-	2	3	-	2	2	-	-	3	2	3	2	-
CO2	3	2	2	3	1	2	-	1	1	3	-	-	-	1
CO3	2	2	-	1	-	1	-	1	-	3	3	2	1	-
CO4	2	3	1	2	-	2	2	2	1	3	2	-	-	-

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

Employability and Entrepreneurship Course

THIRD SEMESTER

Core Course

Code-EnvSc-C303

ENVIRONMENTAL BIOSTATISTICS AND MODELLING

Course Description: The aim of the course is to develop skills on various operating systems, application software, statistical tool and technique and their utility in the field of environmental research and industrial organizations.

Topics	Teaching Hours
UNIT-I	
1) Sampling techniques and data representation 2) Measures of central tendency 3) Measures of dispersion. 4) Distribution.	15
UNIT-II	
1) Probability and Chi-square test. 2) Correlation and linear regression. 3) Tests of significance. 4) Experimental design and analysis of variance.	15
UNIT-III	
1) Computer fundamentals and operating system-function/need of operating system 2) Permanent storage of data, number systems, decimal to binary and vice-versa, binary coded decimal numbers. 3) Low and high level languages. 4) Basic concept of algorithms and flow charting.	15
UNIT-IV	
1) Programming in 'C' and C++ : Introductory concepts. 2) Word Processing: MS- word, Excel and their application. 3) Internet: History, Application, Service provider, computer and ethics-hacking, viruses, abuses. 4) Application of computers in Environmental Science.	15

Suggested Readings: Gallager R., 1996, Discrete Stochastic Processes, Kluwer Academic Publishers. Grant, W.E., Pederson, E.K. and Sendra, L.M., 1997, Ecology and Natural Resource Management: Systems Analysis and Simulation, John Wiley, New York.

Jorgensen, S.E. Miller, F., (Ed.), 2000, Hand Book of Ecosystem Theories and Management, Section-I and 11.4 of Section II. CRC press, Florida.

Recknagal, F., (Ed.), 2003, Ecological Informatics, chapters I, II, III and IV. Springer, Germany.

Wainwright, John (Editor), Mulligan, Mark (Editor), 2004, Environmental Modelling: Finding Simplicity in Complexity. John Wiley, New York

Zannetti, P., 1990, Air pollution modeling, theories computational methods and available softwares. Van NostrandRheinhold, New York.

Course Outcome:-

CO1: Understand the concept of data analysis measures of dispersion and to collect, manage and represent the data via different types of tables and graphs

CO2: Know the aspects and use of probability and distributions and test of significance.

CO3: To describe the basics of computer, different types of operating system and various application software used in the field of environmental sciences.

CO4:. Will get the understanding about the application of computers in environmental science.

Course Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	**3**	**-**	**-**	**1**	**-**	**1**	**-**	**2**	**-**	**-**	**1**	**1**	**1**	**-**
CO2	**3**	**-**	**1**	**-**	**-**	**1**	**-**	**2**	**1**	**-**	**1**	**1**	**1**	**-**
CO3	**3**	**1**	**-**	**2**	**-**	**-**	**-**	**2**	**2**	**-**	**-**	**-**	**-**	**-**
CO4	**3**	**-**	**-**	**-**	**-**	**-**	**1**	**2**	**2**	**-**	**1**	**1**	**1**	**-**

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

Skill Development, Employability and Entrepreneurship Course

THIRD SEMESTER

Elective Course

Code-EnvSc-E304

METEOROLOGY: TOOLS AND TECHNIQUES

Course Description: The aim of the course is to give in depth knowledge about various meteorological parameter. To understand the extraction, isolation and characterization of different environmental samples through different analytical technique

Topics	Teaching Hours
UNIT-I	
1) Meteorological Parameters: Pressure, Atmospheric Pressure belts, temperature, wind and wind roses humidity, precipitation and radiation. Atmospheric stability, inversions, mixing heights. 2) Scales of Meteorology. 3) Dew, Fog, Frost, Haze, Clouds: Cloud development and classification of Clouds. Cloud Bursting and its consequences 4) Air masses and Fronts.	15
UNIT-II	
1) World Climates: Elements of climate, Climatic controls, Classification of climate, Preliminary concept of climate change. 2) Indian climate, seasons in India. Spatial and temporal patterns of climatic parameters in India, Weather Forecasting. 3) Elements of Agro climatology. and EL Nino, Southern Oscillations. 4) Human and animal bio-climatology.	15
UNIT-III	
1) Basic Principle, instrumentation and application of spectroscopy, colorimetry and Flame photometer. 2) Spectroscopy: Basic principle, instrumentation and applications of atomic absorption and emission spectroscopy. 3) Chromatography: Principle, types and application of Gas Chromatography, Gas- liquid chromatography and HPLC. 4) Centrifugation: Basic Principle, Types and instrumentation and application.	15
UNIT-IV	
1) Nephlometer: Principles and Applications. 2) High Volume Sampler, Respirable Dust Sampler, Fine Particulate Sampler: Principle, instrumentation and applications. 3) Titrimetry and Gravimetry. 4) X- ray diffraction.	15

Suggested Readings: Barry, R. G., 2003. Atmosphere, weather and climate. Routledge Press, UK

Critchfield, Howard J., 1998, General climatology, Prentice Hall India Pvt. Ltd., New Delhi,

C. Donald Ahrens, Meteorology Toady Seventh edition .

Course Outcome:-

CO1: Students will gain knowledge about different meteorological parameter and how tomeasured.

CO2: Ability to demonstrate sound understanding of the atmosphere and climate as integral part of the physical environment.

CO3: Execute quantitative and qualitative analyses of various environmental samples through instrumentation techniques

CO4:.Ability to demonstrate sound understanding of analytical techniques applied in environmental analyses.

Course Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	2	2	3	-	-	-	1	2	2	3	2	2	-	-
CO2	3	2	2	-	-	2	1	1	1	3	-	1	-	-
CO3	1	-	-	3	3	3	2	2	1	-	3	3	3	2
CO4	1	-	-	2	3	3	1	1	-	-	3	3	3	-

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

THIRD SEMESTER
Elective Course
Code-EnvSc-E305
ATMOSPHERE AND GLOBAL CLIMATE CHANGE

Course Description: This course provides information about the two main physical realms of the environment, i.e. atmosphere and hydrosphere, along with their interactions and phenomenon, emphasis has been given to impart knowledge on climate change, weather, climate change and global warming, climate change vulnerability, adaptation etc. common for all. It will also give ideas of national and international response on climate change scenario

Topics	Teaching Hours
UNIT-I	
1) Earth systems: Atmosphere, hydrosphere, lithosphere, biosphere and their linkage. 2) Earth's geological history and development and evolution of atmosphere. 3) Fractions of atmosphere. 4) Atmospheric composition.	15
UNIT-II	
1) Ocean: general circulation pattern, air- sea interaction. 2) Wind, Stability and turbulence. 3) EL Nino, Southern Oscillations. 4) Energy Balance of atmosphere.	15
UNIT-III	
1) Natural Climate Change: Records of climate change (Glacial cycle, Ocean sediments, corals, tree rings). 2) Causes and Consequences of Global Climate Change. 3) Role of ocean and forest as carbon sink. 4) Ozone depletion - Stratospheric ozone shield.	15
UNIT-IV	
1) Impact of climate change on human, ecosystem, species distribution, spread of diseases. 2) Extinction risk of temperate- sensitive species. 3) UV effects on human, animal and plants. 4) Policy for climate change: Kyoto, carbon trading, carbon sequestration, carbon footprint, carbon credit and clean development mechanism.	15

Suggested Readings: Barry, R. G., 2003. Atmosphere, weather and climate. Routledge Press, UK

Critchfield, Howard J., 1998, General climatology, Prentice Hall India Pvt. Ltd., New Delhi.

Firor, J., and J. E. Jacobsen, 2002. The crowded greenhouse: population, climate change and creating a sustainable world. Yale University Press.

Glantz, M. H., 2003. Climate Affairs: a primer. Island Press.

Harvey D., 2000, Climate and Global Climate Change, Prentice Hall.

Kump, L. R., Kasting, J.F., and Carne, R. G., 2004. The Earth System. 3 rd Ed. Prentice-Hall

Course Outcome:-

CO1: Ability to understand about different earth system and their link with each other and about atmospheric composition and fraction of atmosphere

CO2: Gain knowledge about energy balance of atmosphere, El Nino, ENSO and ocean circulation.

CO3: Student will learn about the history of climate and consequences of climate change.

CO4:. . Student will gain knowledge about Global and regional trends in green house gas emissions, sea level rise, role of ocean and forest as carbon sink.

Course Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	3	3	3	-	-	2	-	3	2	3	-	-	-	2
CO2	3	3	2	-	-	3	-	2	2	3	-	-	-	-
CO3	3	3	3	1	-	-	-	3	3	3	2	1	-	-
CO4	3	3	3	2	-	-	-	3	3	3	2	-	-	-

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

Skill Development, Employability and Entrepreneurship Course

Third Semester

Core Course

Code- EnvSc-C306

Course Description

The course provides practical exposure to analyze different property of solid waste and also give understanding about the statistical method for data computing.

Course Structure

The following is a detailed syllabus.

1 To determine the moisture content in the given solid waste material.
2 To determine the amount of organic matter in the given solid waste material.
3 To determine the amount of organic carbon in the given solid waste material.
4 To determine the pH of the given solid waste material.
5 Determination of sodium ion concentration by Flame photometer in waste water.
6 Determination of potassium ion concentration by Flame photometer in waste water.
7 Determination of heavy metal concentration by atomic absorption spectroscopy.
8 To calculate the mean, mode median of the given data sample.
9 Calculate variance, standard deviation and coefficient of variation for grouped and ungrouped data.
10 Calculate regression and plot scatter diagram and regression of the given data sample.
11 Compute correlation coefficient and test its significance for grouped and ungrouped data.
12 By applying the paired t test compare the mean of two independent variable of given data sample.
13 Calculate one and two way analysis of variance in the given data sample.
14 Convert the given number into their given respective basses.

Suggested readings: 1. Solid Waste Management - V.K. Prabhakar, Solid Waste Management - Hari Mohan Singh,Manly (2001) Statistics for environmental science and management, Chapman and Hall / CRC Press,Met calf and Eddy (2003) Waste water engineering, Mc Graw Hill International

Course Outcome

By the end of the course, students are expected to be able to:

CO1: Gain practical knowledge about the different property of solid waste.

CO2: Gain practical understanding about the statistical method use in the data modeling.

Course Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	1	-	-	1	-	2	3	2	1	3	-	1	3	-
CO2	-	-	-	-	-	2	-	3	3	-	-	2	3	-

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

Employability and Entrepreneurship Course

FOURTH SEMESTER

Core Course

Code-EnvSc-C401

ENVIRONMENTAL IMPACT AND RISK ASSESSMENT

Course Description: The objective of the curriculum is to impart knowledge on basic understanding about Environmental Impact Assessment its process and methodology, get knowledge about the case studies of different development projects and their risk assessment aspect. The students will be enabling to know about how to apply concepts of EIA in environmental planning.

Topics	Teaching Hours
UNIT-I	
1) Principles and procedures: Nature and purpose of environmental impact assessment (EIA), Worldwide spread of EIA. 2) Environmental impact assessment process, Screening, Scoping and Terms ofReferences (TOR) 3) Impact assessment methodologies. 4) Baseline information, Generalized approaches to impact analysis and prediction	15
UNIT-II	
1) Identification of impacts, mitigation measures and comparison of alternatives. 2) Environmental impact assessment evaluation of proposed action 3) Environmental management plan and Environmental Impact statements 4) Procedure for reviewing, environmental impact analysis and statement.	15
UNIT-III	
1) Case study: River valley projects, thermal Power Plants, mining projects. 2) EIA guidelines 1994, notification of Government of India. 3) Guidelines of environmental monitoring audits. 4) Applications of geographic information system (G.I.S.) in environmental management.	15
UNIT-IV	
1) Risk assessment-Hazard analysis, hazards identification, vulnerability analysis, risk analysis. 2) Risk assessment and comparisons-risk and uncertainty, risks of new technologies, comparison of risks, contrasting risks. 3) Risk consequences: Impacts of serious accidents, uncertainty costs, signal incidents and risk probabilities: Human factors, organizational factors and external social factors. 4) Remote sensing: Principle and applications of remote sensing in environmental science.	15

Suggested Readings: Glasson J., Therivel R., Chadwick. A., 1994, Introduction to environmental impact assessment- Principles and procedures, process, Practice and prospects. Research Press, Delhi.

Morris. P. &Therivel. R., 2001, Methods of environmental impact assessment, 2 nd Ed. Spon Press, New York,

With a chapter on GIS and EIA by A.R. Bachiller& G. Wood, p. 381-401. Petts Judith, 1999, Handbook of environmental impact assessment. Vol. 1, Blackwell Science

Course Outcome:-

CO1: Apply analytical tools like EIA processes and methodologies to determine and measure environmental impacts due to planning of developmental activities/projects.

CO2: Ability to critically examine development actions with the fundamentals understanding of EIA and sustainable development

CO3: Bring in to light the procedure of EIA for various category projects and guidelines of environmental monitoring audit

CO4:.Able to examine environmental risk by its analysis, assessment and management by understanding the steps involved.

Course Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	3	3	3	2	3	2	3	3	2	2	3	2	2	2
CO2	3	3	2	3	3	2	2	2	2	-	3	2	2	3
CO3	3	2	2	-	2	2	1	2	2	-	3	3	2	2
CO4	3	2	2	-	-	2	-	2	1	2	2	-	-	1

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

Skill Development Course

FOURTH SEMESTER

Core Course

Code-EnvSc-C402

ENVIRONMENTAL MANAGEMENT AND LAWS

Course Description: The aim of this course is to developed understanding for various environment policies, planning and legal aspects for environmental conservation and protection in India.

Topics	Teaching Hours
UNIT-I	
1) Environmental management: fundamentals and goals, standards, monitoring, Environmental auditing, types and general methodology of audit. 2) Modelling, And Environmental Management Systems, public participation forenvironmental management. 3) Environmental management and economics: greening of economics, evaluating the environment and natural resources, cost benefit analysis, green taxes, green funding, 4) Debt, structural adjustment and environment, trade and environmental management.	15
UNIT-II	
1) International Standardization Organization (ISO),EMS Certification, ISO 14000 Series, and. ISO-14001 requirements, Difference Between ISO 14000 and ISO14001 Environmental Policy, and Relationship between ISO-9001 and ISO-14001. 2) Environmental protection: Issues and problems, national and international conventions: Stockholm conference 1972, Earth Summit 1992. Montreal Protocol 1987. 3) Policy for climate change: Kyoto, carbon trading, carbon sequestration, carbon footprint, carbon credit and clean development mechanism. Provision ofConstitution of India regarding environment [Article 48 A and 51-A(g)]. 4) Municipal Solid Wastes (Management and Handling) Rules, 2000. Hazardous waste management and handling rules, 1989.Biomedical Waste (Management And Handling) Rules, 1998 and amendment 2016.	15
UNIT-III	
1) The Environmental (Protection) Act, 1986 and rules 1986. 2) Air (Prevention and Control of Pollution) Act, 1981 as amended by 1987 and rule 1982. 3) The Water (Prevention and Control of Pollution) Act, 1974 as amended upto 1988 and rules 1975. 4) The Wildlife Protection Act 1972, amendment bill 1991.	15
UNIT-IV	
1) The Indian Forest Act, 1927 and Forest conservation Act, 1980. 2) The Public Liability Insurance Act, 1991 and rules 1991. 3) Scheme of labelling of environmental friendly products (Ecomark). 4) Motor Vehicle Act, 1988 and Vehicular exhaust emission standards, 1990.	15

Suggested Readings: Bell Stuart &McGillvrayDonal, 2001, Environmental Law, Universal Law Publishing Co.

DiwanShyam and Rosencranz Armin, 2002, Environmental Law and Policy. Hughes David, 1992, Environmental Law, Butterworths.

Jariwala C.M., 2004, Environmental Justice, APH Publishing Corporation, N. Delhi Leelakrishnan. P, 2004, Environmental Law Case Book , Lexis Nexis, ButterworthsMohanty. S. K., 2004, Environment and Pollution Law, Universal Law Publishing Co. Pvt. Ltd.
Singh Gurdip, 2004, Environmental Law in India, Mcmillan& Co.
Singh Gurdip, 2003, International Environmental Law, Macmillan.
Shastri. S. C., 2005, Environmental Law, Eastern Book Company.

Course Outcome:-

CO1: Understand the importance of environmental planning in environmental management.
CO2: Student will gain in depth knowledge about ISO related to environment and will also know about summits related to environmental conservation
CO3: Learns the important provisions ofdifferent environmental laws in India
CO4:.To explain various environmental legislations for the protection of wildlife and forest in India.

Course Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	-	3	2	-	2	2	-	2	2	-	2	1	1	-
CO2	2	2	1	-	2	1	-	2	2	-	2	-	-	-
CO3	3	2	-	2	-	-	-	2	-	-	3	2	-	2
CO4	3	3	-	1	-	-	-	2	1	-	3	2	-	3

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

Employability and Entrepreneurship Course

FOURTH SEMESTER

Elective Course

Code-EnvSc-E403

ENVIRONMENTAL BIOTECHNOLOGY

Course Descriptation: The objective of the curriculum is to acquaint the students about the basic concepts and application of Biotechnology Environmental management

Topics	Teaching Hours
UNIT-I	
1) Natural environmental of microorganisms, the terrestrial environment, aquatic and extreme environment. 2) General characters and basic classification of microorganisms. 3) Structure and growth of microorganisms as related to the environment. 4) Major groups of microorganisms.	15
UNIT-II	
1) Biotechnology for pollution abatement. 2) Use of microorganism in waste treatment and waste management. 3) Bioremediation: Remediation of degraded ecosystem. 4) Role of microorganisms in degradation of pesticides, chemicals, petroleum products and plastics.	15
UNIT-III	
1) Vermiculture technology. 2) Bio fertilizer technology. 3) Role of microorganism in alcohol and acetic acid production, fermentation technology. 4) Composting and Biomethanation.	15
UNIT-IV	
1) Bio toxicity assays to evaluate Effectiveness of Bt spores against pest and beneficial insects. 2) Biological indicators and biosensors. 3) Bioenergy and biofuels. 4) Bio pesticides and bio fertilizers	15

Suggested Readings: Gardner, Simmonds, Snustad, 1991, Principles of Genetics. John Wiley, Eighth Edition.
Mohapatra. P. K., 2006, Text Book of Environmental Biotechnology. I K International. Olguin, E., Sanchez, G. and Hernandez, E., 1999, Environmental biotechnology and cleaner bioprocesses, Taylor & Francis, London.
Rittman, B. E., and McCarty, P. L., 2001, Environmental Biotechnology. Principles and applications. McGraw-Hill, New York.
Scragg, A. H., 2005, Environmental Biotechnology. Oxford University of Press. Wainwright, M., 1999, An introduction to environmental biotechnology. Springer Verlag, New York

Course Outcome:-

CO1: Student will understand and describe the type of microorganisms in the environment

CO2: Aware about the innovative practices bioleaching, bioabsorption and bioremediation and use of biotechnology for industrial pollution control

CO3: Gain knowledge about vermiculture biotechnology waste management, biofertilizers and role of microorganism in fermentation technology

CO4:.Student will get in depth information about bio indicator, biosensor and bio energy generation

Course Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	**1**	**-**	**-**	**-**	**-**	**2**	**-**	**3**	**2**	**3**	**-**	**1**	**-**	**2**
CO2	**3**	**3**	**-**	**-**	**3**	**2**	**3**	**2**	**2**	**3**	**2**	**2**	**1**	**-**
CO3	**-**	**-**	**2**	**3**	**3**	**2**	**2**	**2**	**2**	**-**	**-**	**2**	**-**	**-**
CO4	**3**	**2**	**2**	**-**	**-**	**-**	**1**	**2**	**2**	**2**	**-**	**2**	**-**	**1**

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

Skill Development, Employability and Entrepreneurship Course

FOURTH SEMESTER

Elective Course

Code-EnvSc-E404

ENVIRONMENTAL INSTRUMENTATION

Course Descriptation: The aim of this course is to develop understanding about the various environmental technique for sample analysis of soil, air and water by various technique.

Topics	Teaching Hours
UNIT-I	
Spectroscopy 1) Emission spectroscopy. 2) Atomic absorption spectroscopy 3) Flame photometry 4) Circular Dichroism Spectroscopy	15
UNIT-II	
Centrifugations 1) Principle 2) Types of centrifuges 3) Types of centrifugation 4) Ultra-centrifugation **Air Monitoring Sampler** 5) High Volume Sampler 6) Respirable Dust Sampler 7) Fine Particulate Sampler 8) Gravimetry and titrimetry	15
UNIT-III	
Chromatography 1) Paper chromatography, TLC 2) Column chromatography 3) GLC 4) HPLC	15
UNIT-IV	
1) pH meter 2) Photometry 3) Spectrophotometry 4) Nephalometry 5) Conductivity meter	15

Suggested Readings: Chatwal, Gurdeep R., Sham, Anand, K. 2016 Instrumental method of chemical analysis, Himalaya Publishing Comapany.

Chatwal, Gurdeep R, Sham, Anand, K 2016 Spectroscopy Himalaya Publishing Comapany

Course Outcome:-

CO1: Gain knowledge on how to use different type of spectroscopy in analysis of various samples of air water and soil.

CO2: Student will be able to understand about different type of centrifuge andair monitoring samplers

CO3: Ability to apply the use of chromatography in sample analysis

CO4: Student will gain in depth knowledge about nephalometry, photometry and spectrophotmetery in various sample analysis.

Course Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	2	2	-	3	3	3	3	2	1	-	-	3	1	2
CO2	2	3	-	3	3	3	2	1	-	-	-	2	-	-
CO3	3	2	-	2	3	2	3	-	2	-	2	-	-	2
CO4	2	3	1	2	3	1	2	-	1	-	2	-	-	1

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

Employability and Entrepreneurship Course

FOURTH SEMESTER

Elective Course

Code-EnvSc-E405

ECOTOXICOLOY AND ENVIRONMENTAL HEALTH

Course Descriptation: The objective of the curriculum is to acquaint the students about the Occupational hazards, Xenobiotic compoundsas pollutants and disease-causing microbial agents affecting human health.

Topics	Teaching Hours
UNIT-I	
1) Principles in toxicology, aquatic and animal toxicity tests. 2) Statistical concept of LD50 and LC50. 3) Dose response and Dose effect relationship, Dose response curve. 4) Biological, chemical and ecological factors that influence toxicity.	15
UNIT-II	
1) Major classes of environmental pollutants – Heavy Metals, Gases, Pesticides and Fertilizers. 2) Biotransformation and it's processes. 3) Bioaccumulation and Bio magnification. 4) Toxicants effects – Cellular, Organismic, Population and Ecosystem level.	15
UNIT-III	
1) Biochemical teratogenicity and it's effect. 2) Carcinogenicity of environmental pollutants. 3) Environmental toxins and human health. 4) Microbial toxins.	15
UNIT-IV	
1) Water borne diseases, air borne diseases. 2) Vector transmitted diseases. 3) Food – borne diseases. 4) Occupational Health.	15

Suggested readings: Newman, M.C, Lawrence, C.A., and Unger. M.A., 2002. Ecotoxicology: Fundamentals of Ecotoxicology, 2 nd Ed., CRC Press, Boca Raton, Florida.

Walker, C.H., Hopkin, S.P., Sibly, R.M., and Peakall, D.B. 2001. Principles of Ecotoxicology. 2 nd Ed. Taylor & Francis, London.

Moore, G.S., 2002, Living with the Earth: concepts in Environmental Health Science (2 nd Ed.), Lewis publishers, Michigan.

Selinus, Alloway, Centeno, Finkelman, Fuge, Lindh, Smedley; 2005, Essential of Medical Geology; Elsevier Academic Press.

Course Outcome:-

CO1:knowing about the principles of toxicology, Know the dose response relationship and factors that influence toxicity.

CO2: Moreover, the students would acquire knowledge about the toxicants and their route of entry to the environment and its consequences.

CO3: Understand the fate of toxicants and transport of toxicants in food chain

CO4:.to know the occupational health hazards associated with different occupations and occurrence of industrial disasters.

Course Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	**3**	**-**	**-**	**2**	**-**	**2**	**-**	**3**	**1**	**3**	**-**	**-**	**1**	**2**
CO2	**3**	**3**	**2**	**3**	**-**	**2**	**-**	**2**	**1**	**3**	**-**	**-**	**-**	**-**
CO3	**3**	**2**	**-**	**3**	**-**	**-**	**-**	**2**	**-**	**3**	**-**	**-**	**-**	**1**
CO4	**3**	**3**	**-**	**2**	**-**	**-**	**-**	**2**	**-**	**3**	**-**	**-**	**-**	**-**

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

FOURTH SEMESTER
Elective Course
Code-EnvSc-E406
ENVIRONMENTAL HAZARDS

Course Descriptation: The objective of the curriculum is to acquaint the students about the concept of various geological hazards and their prediction and mitigation.

Topics	Teaching Hours
UNIT-I	
1) Concept of geological hazards – continental drift theory. 2) Plate – tectonic theory. 3) Distinction between natural hazards and anthropogenic hazards. 4) Prediction and perception of hazards.	15
UNIT-II	
1) Geological Hazard :Earthquake, Earthquake destruction and prediction 2) Geological Hazard :Volcanism, Volcanic activity, Igneous activity and Material Extruded during eruption 3) Geological Hazard : Mass – movement, Landslide and its prediction 4) Geological Hazard: Tsunami. And its consequences, Mitigation measures and early warning	15
UNIT-III	
1) Hydrological Hazard: Floods and its types, River topography ,causes and its prediction 2) Hydrological Hazard: Drought and its types 3) Hydrological Hazard: Tropical Cyclones and Anticyclone, Hurricanes, Tornedo 4) Atmospheric climatic hazards.	15
UNIT-IV	
1) Technological hazards: Bhopal, Three Mile Island and Chernobyl disasters. 2) Biophysical Hazard – frost, Epidemics. 3) Cloud Bursting and its consequences 4) Disaster management.	15

Suggested Readings: Bell. F.G, E & FN Spon, 1999, Geological Hazards: Their Assessment, Avoidance and Mitigation, e Books der ULB Darmstadt.

Burton. I, Kates. R.W and White. G.F, 1993, Environment as Hazard Guilford Press. Casale. R and Margottini. C. (Ed.), Springer, 2004, Natural Disasters and Sustainable Development

Hewitt. K., 1997, Regions of risk, Longman Press.

Henrry J.G. and Heinke , G.W., 2004, Environmental Science and engineering, Pearson education, Delhi, India.

Keller. Edward A, 1996, Introduction to Environmental Geology, Prentice Hall, Upper Saddle River, New Jersey

Smith Keith, 2001, Environmental Hazards: Assessing Risk and Reducing Disaster, Routledge.

Course Outcome:-

CO1: Understand the geophysical processes as the drivers of different types of hazards.
CO2: Will be able to understand and differentiate the different types of disasters, analyse the causes and their potential impact on the natural and man-made environments
CO3: Gain knowledge about different hydrological hazard, their occurrence and their types.
CO4:.Aware the different Strategies for mitigation disaster management and knowledge about different technological hazards.

Course Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	**2**	**3**	**2**	**-**	**3**	**3**	**2**	**3**	**2**	**2**	**3**	**2**	**1**	**-**
CO2	**2**	**3**	**3**	**-**	**2**	**3**	**-**	**3**	**-**	**2**	**2**	**2**	**-**	**-**
CO3	**3**	**3**	**1**	**-**	**2**	**2**	**1**	**2**	**-**	**2**	**2**	**3**	**-**	**-**
CO4	**3**	**3**	**-**	**3**	**2**	**-**	**-**	**2**	**2**	**-**	**3**	**2**	**-**	**2**

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

Skill Development, Employability and Entrepreneurship Course

Fourth semester

Core Course

Code - EnvSc-C407

Practical

Course Description

The course provides practical exposure to biochemical estimation of different parameters in blood serum and gives understanding about structure of microorganism.

Course Structure:

The following is a detailed syllabus.

Biochemical estimation of different parameters in serum and blood viz.

1 total protein.
2 Serum albumin
3 Serum globulin
4 Albumin to Globulin ratio

Serum lipids

5.Serum cholesterol
6.High Density Lipoprotein
7.Low Density Lipoprotien
8.Triglyceride
9.Very Low Density Lipoprotien
10.To study the bacteria present in a curd sample.
11.To identify the microorganism which spoil the food material.
12. To understand the morphological structure of various microorganism.
Volvox
Zygnema
Yeast
Fucus
Penicillium
Ustilago
Amoeba
Paramecium
Euglena
13. Case Study: Environmental Impact assessment

Suggested Reading: Barthwal R.R. (2002): Environmental Impact Assessment, New Age International (P)Ltd . Pub New Delhi, Environmental Microbiology - Ralph Mitchell and Ji-Dong Gu, Environmental Microbiology: A Laboratory Manual - Ian L. Pepper and Charles P. Gerba

Course Outcome

By the end of the course, students are expected to be able to:

CO1: Gain practical knowledge about estimation of different biochemical parameter in blood serum.

CO2: Gain practical understanding about the structure of different microorganism and slide preparation.

Course Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	-	-	-	1	2	1	2	1	-	-	-	-	2	-
CO2	-	-	-	1	2	1	2	1	-	-	-	-	2	-

Matching: * 0 to 30% = 1; *30% to 60% = 2; * 60% to 100% =3

Dr. B. R. Ambedkar University, Agra

(Formerly: Agra University, AGRA)

Date: 17-09-2022

Meeting of the Board of Studies/ Academic Committee for P.G. Diploma in Yoga Education (PGDYE-One Year Course: Two Semester), Master in Physical Education & Sports Sciences (MPES-Two Year: Four Semesters) and B.A. in Yoga (BAY-Three Years: Six Semesters) and M.A. in Yoga (MAY- Two Years: Four Semesters) held on 17-09-2022 at 11.00am in the Department of Library & Information Science, Paliwal Park, Dr. B.R.A. University, Agra.

The Following members were present in the meeting –

1. Prof. U.C. Sharma (Dean Arts)
2. Dr. Akhilesh Chand Saxena (Convenor)
3. Dr. Dhanajay Singh, Assistant Professor, R.B. S. College, Agra (Subject Expert)
4. Dr. Sheeldhar Dubey, Associate Professor, PDDU College, Lucknow (Subject Expert)
5. Dr. S. N. Singh, Professsor, S.D. PG College, Muzaffarnagar (Subject Expert)
6. Dr. Ram Ji Mishra, Assistant Professor, Patanjali University (Subject Expert)

MINUTES

1. The Committee confirms the minutes of previous meeting with appreciation.
2. The syllabus as per CBCS of P.G. Diploma in Yoga Education (PGDYE) thoroughly studied by the committee and passed with warm appreciation. The theory subjects and practical of this course are given in the Enclosure-1.
3. The syllabus as per Two Year Course having four semester on the basis of CBCS for Master in Physical Education & Sports Sciences (MPES) thoroughly studied by the committee and passed with positive appreciation. The details of theory subjects and practical of this course are given in the Encloser – 2.
4. The syllabus as per three Year Course having six semester on the basis of CBCS for B.A in Yoga (BAY) thoroughly studied by the committee and passed with appreciation. The details of theory subjects and practical of this course are given in Encloser-3.
5. The syllabus as per two Year Course having four semester on the basis of CBCS for M.A. in Yoga (MAY) thoroughly studied by the committee and passed with appreciation. The details of theory subjects and practical of this course are given in Encloser-4.
6. The committee also submitted the list of examiners for the M.A. in Yoga (MAY) course and for other above three courses lists were already submitted in the previous meeting held on 29/04/2022.
7. The committee has discussed and decided that the list of examiners will be approved in the further meeting.
8. The meeting ends with the vote of thanks.

Note : Committee has decided to amend the above courses as per National Education Policy (NEP), if it required.

Dr.B.R.AmbedkarUniversity,Agra
(Formerly:Agra University, AGRA)

CURRICULUMFOR

POST GRADUATE DIPLOMA IN YOGA EDUCATION(PGDYEd)

PROGRAMMEONEYEAR-(TWOSEMESTERS)

ORDINANCE,REGULATIONS ANDSYLLABUSFORPGDYEd.(CBCS)

Preamble

ThetraditionofYogahasalwaysbeenpassedonindividuallyfromteachertostudentthrough oral teaching and practical demonstration. The formal techniques that are now known asYoga are, therefore, based on the collective experiences of many individuals over manythousandsofyears.Theparticular mannerin whichthe techniquesaretaught andpracticed todaydepends on theapproachpassed down in thelineof teachers supportingtheindividualpractitioner. Yoga is essentially a spiritual discipline based on an extremely subtle science,whichfocuses on establishingharmonybetween mind,body; thoughtand action;restraint andfulfillment;harmonybetweenmanandnatureandaholisticapproachtohealthand wellbeing.

Inadditiontothis,Yogaisbecomingpopulardaybydayandhasbecomeawavewhichis sweeping across the globe. In this course we introduce yoga as a science of**Holistic Living**and not merely as yoga postures. During the course the student is taught the concepts of Yoga for thetreatmentandprevention ofvariouspsychosomatic ailments.Thiscourselooks attraining theenthusiaststobecomeYogatherapistsothattheycouldteachyogaunderthesupervisionofadoctor for health andhealing.

1. Titleof thePrograмme

Theprogrammeshallbecalled"**Post Graduate Diploma in Yoga Education"(PGDYEd)**
Tomakethepeopleawareofthetherapeuticand preventivevalueof Yoga.

1. To bringpeaceandharmonyinthe societyatlargebyintroducingthe Yogicwayoflife.
2. To create therapists of high caliber to make the society free from stress and lifestylerelated diseases.

1.Eligibility

A) CandidateseekingadmissionPost Graduate Diploma in Yoga Education(PGDYEd)programmustbegraduate with 50 % fromUGC recognized institution.

B) Theprovisionofseatsandtherelaxationinqualifyingmarksfor SC/ST/OBCandothercategories shallbeaspertherulesofthecentralgovernment/stategovernment.Whicheverisapplicable

2. Post Graduate Diploma in Yoga Education"(PGDYEd)Degree: Thecandidatesshall havesubsequentlyundergonetheprescribedcourseofstudyin the universitydepartment or a college affiliated to his University for a period of not less than twoacademic years, passed the examinations prescribed and fulfilled such conditions as have been prescribedthereforPost Graduate Diploma in Yoga Education"(PGDYEd).

3.Duration:

The PGDYEd.program shall be of duration of one academic years, that is,two semesters. However,
thestudentsshallbepermittedtocompletetheprogramrequirementswithinamaximumoftwoye arsfromthedateofadmission.

4.TheCBCSSystem:

All Programs shall run on Choice Based Credit System (CBCS). It is an instructional package developed tosuit the need of students, to keep pace with the developments in higher education and the quality assuranceexpectedofitinthelightofliberalizationandglobalizationinhighereducation.

5. Courses

Thetermcourseusuallyrefereed to, as'papers'isa component of aprogram.All coursesneednot carrythesame weight. The courses should define learning objectives and learning outcomes. A course may bedesigned to comprise Lecturer/tutorials/ laboratory work/fieldwork/Outreach activity (Educational Toursactivities)/ project work/vocational training/viva/seminars/term papers/assignments/ presentations/self-studyetc.oracombinationofsomeofthese.

6.CoursesofProgram:

ThePGDYEdProgramconsistsofanumberofcourses,theterm'Course'appliedtoindicatealogical part ofsubjectmatter of the Programand is invariably equivalentto the subject matter of a "paper" in theconventionalsense.Thefollowingarethevariouscategoriesofcoursessuggestedforthe PGDYEdProgram.

7.Semesters:

An academic year is divided in to two semesters; each semester will consist of 17-20 weeks of academicwork equivalent to 100 actual teaching days excluding examination days. The odd semester may bescheduled fromJuly to December and even semester from January to June.Theinstitutionshallworkforaminimumof36workinghoursinaweek(fiveorsixdaysaweek).

8.WorkingDay:

Thereshallbeatleast200workingdaysin ayearexclusiveofadmissionandexaminationprocessesetc.

9.Credits:

Theterm'Credit'referstoaunitybywhichtheprogramis measured. Itdeterminesthenumberofhours ofinstructions required per week. One credit is equivalent to one hour of teaching (lecture or tutorial) or oneand half/twohoursofpracticalwork/fieldworkperweek.Theterm'Credit'refersto the weightgiventoacourse. Usually in relation to the instructional hours assigned to it. The total minimum credits, required forcompletingaPGDYEdProgramis52creditsandforeachsemester26credits.

10.Examinations:

i. Thereshallbeexaminationsattheendofeachsemester,forfirstsemesterinthemonthofDecember/January: for second semester in the month of May/June. A Candidate who does not pass theexaminationinanySubjectsshallbepermittedtoappearinsuchfailedsubjectsinthesubsequentexaminationstobeheldinNovember/DecemberorMay/June.

ii. A candidate should get enrolled/registered for thefirst semester examination. If enrollment/registration isnotpossibleowingtoshortageofattendancebeyondconditionlimit/rulesprescribedORbelatedjoiningORon medical grounds, such candidates are not permitted to proceed to the next semester. Such candidatesshall redo the semester in the subsequent term of the semester as a regular student; however, a student offirst semester shall be admitted in the second semester, if he/she have successfully kept the term in firstsemester.

11.Conditions:

Student must have 75% of attendance in each course for appearing the examination. Students who have74%to65%ofattendanceshallapplyforconditionintheprescribedformwiththeprescribedfee.Studentswhohave64%to50%ofattendanceshallapplyforconditioninprescribedformwiththe

prescribedfeealongwiththeMedicalCertificate.Studentwhoparticipateinsportscompetition affiliatedbyIOAshallapplybeconsideredinexaminationwiththepermissionofheadofthedepartment.Studentswhohavebelow50%ofattendancearenoteligibletoappearfortheexamination.

12.PatternofQuestionPapers:

QuestionPapersshallhavefivequestionscorrespondingtofourunitsofeachtheorycourse.

PGDYEd.:FormatofQuestionsPaper For 4Units

Eachquestionpapershallhavefivequestions.Thepatternwillbeasfollows:

QuestionNo.	Description	Marks
1	**Answerindetail(LongQuestion)Or** Answerindetail(LongQuestion)(FormUnit1)	15
2	**Answerindetail(LongQuestion)Or** Answerindetail(LongQuestion)(FormUnit2)	15
3	**Answerindetail(LongQuestion)Or** Answerindetail(LongQuestion)(FormUnit3)	15
4	**Writeshortnotes:anytwooutoffour (FormUnit4)**	15
5	M.C.Q.TypeQuestions(15outof15Question) (fromeachunit)	15
Total		75

13. Evaluation:

Theperformanceofastudentineachcourseisevaluatedintermsofpercentageofmarkswithap rovisionforconversiontogradepoint.Evaluationforeachcourseshallbedonebyacontinuous internal assessment (CIA) by the concerned course teacher as well as by end semester examination
andwillbeconsolidatingattheendofcourse.Thecomponentsforcontinuousinternalassessm entare:

OneTest	**10 Marks**
Seminar/Quiz	**5 Marks**
Assignments	**5 Marks**
Attendan ce	**5 Marks**
Total	**25 Marks**

Attendance shall be taken as a component of continuous assessment, although the students should haveminimum 75% attendance in each course. In addition to continuous evaluation component, the endsemesterexamination,whichwillbewrittentypeexaminationof
atleast1hoursduration,wouldalsoforman integral component of the evaluation. The ratio of marks to be allotted to continuous internalassessment and to end semester examination is 25:75. The evaluation of practical work, whereverapplicable, will also be based on continuous internalassessment and on an end-semester practicalexamination.

14. MinimumPassingStandard:

The minimum passing standard for CIA (Continuous Internal Assessment) and External Examinationsshall be40%,i.e.10marksoutof25marks and30marksoutof75marksrespectivelyfortheorycourse.The minimum passing for both CIA & external examination shall be 40%, i.e. 10 marks out of 25 and 30marksoutof 75 Marksforthepracticalcourses.

15. Awardofthe PGDYEd.Degree:

A candidate shall be eligible for the award of the degree of the PGDYEdOnly if he/she has earned theminimumrequiredcredit.

16. **Assessment andEvaluations:TOTAL MARKINGSYSTEM**

[SEMESTER	THRORETICAL	PRACTICAL	CREDITS
Semester–1	400	200	26
Semester–2	400	200	26
Total	800	400	52

I. Eachcoursewillbeassessedonthebasisof100marks. Themarkswouldbedividedbetweeninternalandexternalassessment.

II. Thereshallbeoneendsemesterexternalexaminationforeachcourseineverysemesterconsistingof 75%(75marks)weightintheoryand75%(75marks)inpracticalcourses.

III. Each

Theorycourseshallhaveinternalassessmentof25%weightageonthe

following Internalwrittentest-10%(10marks)Attendance-

05%(5marks)

Classparticipationinassignments-05%(5marks)Presentations(Seminars)/quizzesetc.-05%(5marks)

Total 25marks

IV. EachPracticalCourseshallhaveinternalassessmentof

25%weightageonthefollowing OneTest10marksProject10marks

Attendance05marks

Total 25marks

V. Everystudentwillberequiredtopasstheexternalexaminationandinternalassessmentseparatelyineachcourse.

VI. The minimum passing standard will be 40% for the external and internal component of each theorycourse, i.e. 30 marks out of 75 and 10 marks out of 25.In practical minimum passing standard will be40%

fortheexternalexamandinternalassessmentforeachpracticalcourse.

VII. Attendanceshallbetaken asacomponentforcontinuousassessment,althoughthestudentsshouldputinminimum of 75% attendance in each course. In addition to continuous evaluation component, the endsemester examination, which will be written type examinations of at least 1 hours duration, would alsoform an integral component of the evaluation. The ratio of marks to be allotted to continuous internalassessmentandtoendsemester,examinationis25:75intheory& 25:75 inpractical.

VIII.(A) The grades for each course would be decided on the basis of the percentage of marks obtained intheend-semesterexternalandinternalexaminationsasperthefollowingtable:

Percentage	GradePoint	Grade	Description	Classification of finalresult
85&above	8.5-10.0	O	Outstanding	FirstclasswithDistinction
70-84.99	7.0-8.49	A+	Excellent	
60-69.99	6.0-6.99	A	VeryGood	FirstClass
55-59.99	5.5-5.99	B+	Good	HigherSecondClass
48-54.99	4.8-5.49	B	Fair	SecondClass
40-47.99	4.0-4.79	C	Average	PassClass
Below40	0.0	D	Fail/Dropped	Dropped

IX. Thesemestergradepoint average(SGPA)will becalculatedasaweightedaverageofall thegradepointofthesemestercourses.ThatisSemestergradepointaverage(SGPA)=(sumofgradepointsofallsixcoursesofthesemester)/totalcreditofthesemesterasperexamplegivenbelow:

CourseNo	Credit	Marks out of100(%)	Grade	GradePoint	Credit Gradepoint
Course-1	5	65	A	6.5	26
Course-2	5	60	A	6.0	24
Course-3	5	62	A	6.2	24.8
Course-4	5	57	B+	5.7	22.8
Course-5	3	55	B+	5.5	22
Course-6	3	72	O	7.2	28.2
Total	26				147.8

Examples:Conversionofmarksintogradepoints

65=60+5=6.0+5x(0.99/9.99)=6.0+5x0.1=6.0+0.5=6.5

57=55+2=5.5+2x(0.49/4.99)=5.5+2x0.1=5.5+0.2=5.7

72=70+2=7.0+2x(1.49/14.99)=7.0+2x0.1=7.0+0.2=7.2

X. SEMESTERGRADEPOINTAVERAGE(SGPA)=TotalCreditGradePoints=147.8/24=6.16SGPASem.I=

6.16 SGPA Sem. II

=

5.63SGPASem.III=6

.01SGPASem.IV=5.5

0

TotalSGPA=23.30

CumulativeGradePointAverage(CGPA)=23.30

4=5.82CGPA=5.82Grade=B+Class=HigherSecondCla

ssGPAX10=Percentagee.g.5.82X10=58.2%

Note:

(1) SGPAiscalculatedonlyifthecandidatepassesinallthecoursesi.e.getminimumCgradeinallthecourses.

(2) CGPAiscalculatedonlywhenthecandidatepassesinallthecoursesofallthesemesters.

XI. Thecumulativegradepointaveragewillbecalculatedas theaverageoftheSGPAofallthefoursemesters,asshownabove.

XII. Forthawardoftheclass,CGPAshallbecalculatedonthebasisof:

(a) MarksofEndSemesterExternalExaminationAnd

(b)TotalMarksobtained(MarksofEndSemesterExternalExamination

+MarksofInternalAssessment)foreachcourse.ThefinalClassforM.A.Y. Degreeshallbe awardedonthebasisoflowestCGPA(marks)of(a)&(b)ofone tofourthsemesterexaminations.

17.ConfermentofthePGDYEd.Degree:

(i)Acandidateshallbeeligiblefortheconfermentoftheegreeof PGDYEdonlyifhe/shehasearnedtheminimumrequiredcreditsfortheprogramprescribedtherefore(i.e.52Credits).

18.EndSemesterExamination:

(i) TheUniversityshallconductheexternalExaminationfortheSemester-I&II.Theinternalexaminationshallbeconductedbytheconcernedbepartments.

SCHEME OF EXAMINATIONS
POST GRADUATE DIPLOMA IN YOGA EDUCATION (PGDYEd)

SEMESTER–I

PART – A (THEORY)										
Paper No.	Paper Code	Name of Subjects	Max. Marks		Min. Pass Marks		Sessional Marks	Aggregate Pass Marks	Total Marks	Credits
			Theory	Practical/ Viva-voce	Theory/ Practical	Sessional				
I.	PGDY CC-101	Fundamentals of Yoga	75	-	30	10	25	40	100	5
II.	PGDY CC-102	Foundation & Practices of Hatha Yoga	75	-	30	10	25	40	100	5
III.	PGDY CC-103	Applied Anatomy and Physiology	75	-	30	10	25	40	100	5
IV.	PGDY CC-104	Naturopathy	75	-	30	10	25	40	100	5
								TOTAL	**400**	**20**
PART B PRACTICALS AND LESSON PLAN										
I.	PGDY PC-101	Yoga Practical-I	-	75	30	10	25	40	100	3
II.	PGDY PC-102	Naturopathy Practical	-	75	30	10	25	40	100	3
								TOTAL	**200**	**6**
								GRAND TOTAL	**600**	**26**

SCHEME OF EXAMINATIONS
POST GRADUATE DIPLOMA IN YOGA EDUCATION (PGDYEd)

SEMESTER–II

PART – A (THEORY)										
Paper No.	Paper Code	Name of Subjects	Max. Marks		Min. Pass Marks		Sessional Marks	Aggregate Pass Marks	Total Marks	Credits
			Theory	Practical/ Viva-voce	Theory/ Practical	Sessional				
I.	PGDY CC-201	Patanjali Yoga Sutra	75	-	30	10	25	40	100	5
II.	PGDY CC-202	Arham Yoga	75	-	30	10	25	40	100	5
III.	PGDY CC-203	Principles of Psychology and Counseling	75	-	30	10	25	40	100	5
IV.	PGDY CC-204	Alternate Therapy	75	-	30	10	25	40	100	5
								TOTAL	**400**	**20**
PART B: PRACTICAL AND LESSON PLAN										
I.	PGDY PC-201	Yoga Practical-II	-	75	30	10	25	40	100	3
II.	PGDY CP-202	Alternate Therapy Practical	-	75	30	10	25	40	100	3
								TOTAL	**200**	**6**
								GRAND TOTAL	**600**	**26**

SEMESTER–I

PAPER- I: FUNDAMENTALS OF YOGA

Subject Code: (PGDY CC-101)

UNIT – I

1. INTRODUCTION TO YOGA AND INDIAN PHILOSOPHY

1.1 Brief introduction to origin of Yoga, History and development of Yoga

1.2 Etymology and definitions of Yoga, Aim, Objectives and Misconceptions about Yoga, True Nature of Yoga

1.3 General introduction to Shad-darshana, Salient features of Indian Philosophy, Branches of Indian Philosophy (Astika and NastikaDarshanas)

1.4 General introduction to Prasthanatrayee and PurusharthaChatushtaya.

UNIT – II

2. BRIEF SURVEY OF YOGIC TRADITIONS – I

2.1 Brief introduction of Vedic Literture, Concept of Yoga in Veda

2.2 General Introduction to Upanishada, Concept of Yoga in Upanishada

2.3 General introduction to Bhagavadgita, Yoga in Bhagawadgita

2.4 Concept of Yoga in Yoga Vashishtha.

UNIT-III

3. BRIEF INTRODUCTION TO YOGA PARAMPARAS IN CONTEMPORARY TIMES

3.1 Life & message of Swami Vivekananda, ShriAurobindo,

3.2 Yoga Parampara of Sri T. Krishnamacharya, and Yogacharya B.K.S Iyengar& Swami DhirendraBhramhachary in the promotion of Yoga.

3.3 Yoga Parampara of Swami Shivanada, ShyamacharanLahiriMahashaya

3.4 Contribution of Sri Yogendraji, Swami Kuvalyananda

UNIT – IV

4. GENERAL INTRODUCTION TO SCHOOLS OF YOGA

4.1 **Jnana Yoga:** Meaning of Jñāna and Jñāna-yoga, Sadhana-chatushtaya, Means of Jñāna-yoga.

4.2 **Bhakti Yoga:** Meaning of Bhakti and Bhakti-yoga, Stages of Bhakti, Types of Bhakti, Means of Bhakti-yoga.

4.3 **Karma Yoga:** Meaning of Karma and Karma-yoga, Concept of Nishkama Karma, Inter relationship between Bhakti-yoga and Karma-yoga, Theory of Karma and Rebirth (Reincarnation).

4.4 **Raja Yoga:** Meaning, definition of Raja Yoga, Ashtanga Yoga, relationship between Hatha Yoga & Raja Yoga.

REFERENCE:

1. Gupta, S.N Das, (1963), "Indian Philosophy", ShriJainendra Press, New Delhi, ISBN-81-208-0412-0.
2. Anatharaman, T.N., (1996), "Ancient Yoga and Modern Science", Project of History of Indian Sciences Philosophy & Culture,-ISBN 8121507529
3. Sturgess, Stephen, (1996), "The Yoga Book", Watkins Publications, London, University of Michigan
4. Kumar, Dr. Kamakhya, (2008), "Super Science of Yoga", Standard Publications, New Delhi ISBN-8187471409
5. Dasgupta, S.N., (1924), "Yoga Philosophy",The May Flower Press, UK.
6. Jha, Gangadhar, (1894), "Yoga Sara Samgraha" --Bombay Theosophical Fund, TatvaVivechaka Press, Bombay

SEMESTER–I

PAPER- II: FOUNDATION & PRACTICES OF HATHA YOGA

Subject Code: (PGDY CC-102)

UNIT –I

1. **INTRODUCTION TO HATH YOGA**

1.1 Hathayoga: Philosophy, Origin, Definition, Objectives and Misconceptions.

1.2 Hathyoga: History and development, Brief Introduction to eminent Hatha Yogis of NathaParampara and their contribution to Yoga.

1.3 Time and Place, Dress Code & Environment for Hatha Yoga, Concept of Mitahara, Pathya and Apathya, SadhakaTatva, BadhakTatva, Hathsiddhilakshana (as per Hatha Yoga Pradipika).

1.4 Introduction of Asanas, Shatkarmas - Meaning, Definitions, Principles, Types, Technique, Precautions and Benefits. (as per Hatha Yoga Pradipika).

UNIT –II

2. **KUMBHAKA, MUDRAS, BANDHAS, NADANUSANDHANA (AS PER HATHA YOGA PRADIPIKA).**

2.1 Kumbhaka :- Meaning, definition, Types of Kumbhaka, Technique, Precautions & Benefits.

2.2 Mudras and Bandhas – Meaning, Definition, Technique, Precautions and Benefits.

2.3 Chakras, Kundalini and Nadis

2.4 Nadanusandhana andVarious types of Samadhis

UNIT-III

3. **INTRODUCTION OF GHERANDA SAMHITA**

3.1 Introduction and History ofGherandaSamhita

3.2 Concept of Ghatasth Yoga. Saptasadhana:-Shatkarma, Asanas, Mudra, Pratyahara, Pranayama, Dhyana, Samadhi.

3.3 Shatkarma- Meaning, Types (Dhauti, Basti, Neti, Trataka, Nauli and Kapalabhati) Technique, Precautions and Benefits.

3.4 Asanasand Mudras -Meaning, Definition Types, Technique, Precautions and Benefits.

UNIT –IV

4. **PRATYAHARA AND PRANAYAMAS (AS PER GHERANDA SAMHITA).**

4.1 Pratyahara – Meaning, Types, Technique, Precautions and Benefits.

4.2 Concept of Prana, Types of Prana and their functioning,,Pranayamas – Meaning and Definition, Types, Technique, Precautions and Benefits.

4.3 Dhayana- Meaning, Types, Technique, Precautions and Benefits.

4.4 Samadhi - Meaning, Types, Technique, Precautions and Benefits.

REFERENCE:

1. Digambarji, Swami (1998), "Hatha Pradipika of Svatmarama", - ISBN: 9788189485122, Publisher: Kaivalyadhama, SMYM Samiti, Lonavala - Pune.

2. Muktibodhananda, Swami (1998), "Hatha Yoga Pradipika" - Light on Hatha Yoga, - ISBN: 81-85787-38-7, Publisher: Yoga Publications Trust, Ganga Darshan, Munger, Bihar, India.

3. NiranjanandaSaraswati, Swami (2012), "GherendaSamhita" - ISBN : 9381620199, Publisher: Yoga Publications Trust, Ganga Darshan, Munger - Bihar, India.

4. NiranjanandaSaraswati, Swami (2009), "Prana and Pranayama", - ISBN: 978-81-86336-79-3, Publisher: Yoga Publications Trust, Ganga Darshan, Munger - Bihar, India.

5. Bhardwaj, Yogeshwar (2004), "Textbook of Yoga"- ISBN: 0143029657, Publisher:Penguin - India.

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SEMESTER–I

PAPER- III: APPLIED ANATOMY AND PHYSIOLOGY

Subject Code: (PGDY CC-103)

UNIT- I

1. GENERAL HUMAN ANATOMY AND PHYSIOLOGY

1.1 Introduction of Anatomy and Physiology, importance and need in field of yoga

1.2 Cell - Structure Composition, function and its types; Types of Tissues, their structure and functions; Brief introduction of different organs and systems of human body

1.3 Digestionsystem; Excretory System; Urinary System, (Structure and Functions in brief).

1.4 Effect of yogic practices on digestive and excretory system (asana, pranayama, mudra, bandha, kriyas and meditation)

UNIT- II

2. MUSCULO– SKELETAL SYSTEM

2.1 Skeletal system - Introduction, Composition of bone.

2.2 Classification and division of skeleton, Joints and their movements.

2.3 Muscles, their types and role.

2.4 Effect of yogic practices on muscular and skeletal system (asana, pranayama, mudra, bandha, kriyas and meditation).

UNIT-III

3. CARDIO RESPIRATORY SYSTEM

3.1 Structure and functions of Heart and Lungs, Cardiac Cycle, Cardiac Output, Stroke Volume.

3.2 Muscles and Mechanism of Respiration, Second Wind, Oxygen Debt.

3.3 Internal and External Respiration, Respiratory Volumes and Pulmonary Ventilation.

3.4Effect of yogic practices on cardio respiratory system (asana, pranayama, mudra, bandha, kriyas and meditation).

UNIT-IV

4. NERVOUS AND HORMONAL SYSTEM

4.1 Nervous System: Structural and Functional Divisions of Nervous System– PNS, ANS, and Sensory Motor Nervous System. Parts of Brain and their functions.Structure and Functions of Spinal Cord.

4.2 Endocrine Glands and Exocrine Glands. Structure and Functions of Adrenal, Pituitary, Pancreas and Thyroid Glands.

4.3 Introduction to Sense Organs: Eyes, Ears, Nose and Skin.

4.4 Effect of yogic practices on nervous and hormonal system (asana, pranayama, mudra, bandha, kriyas and meditation)

REFERENCES:

1. Coutter, H.D. (2001), "Anatomy of Hath Yoga" Published by Himalayan Institute India, Jhansi, Allahabad, ISBN-978-0-9797006-1-2.
2. Saraswati, S. (2009), "Yoga Nidra" Published by Yoga Publication Trust, Bihar, India (Reprint) ISBN-978-81-83787-12-1.
3. Maehle, G. (2008), "Ashtanga Yoga Practice & Philosophy" First Indian Edition Published by, New Age Books, New Delhi (Reprint), ISBN-978-81-78-22-329-2.
4. Karambelkar, P.V. (2011), "Patanjali Yoga Sutra" Published by Kawalyadham S.M.Y.M. Publications Pune, India. ISBN-81-89-415-17-2.
5. Martini, F.H. et al (2000), "Applications Manual for Essentials of Anatomy & Physiology" Second Edition by Prentice Hall Inc., U.S.A. ISBN-0-13-014662-5.
6. Chaurasia, B.D. (2014), "Human Anatomy" Vol.-1, Fourth Edition, CBS Publishers and Distributors, New Delhi. ISBN-81-239-1155-6.
7. Shiva, V.K. (2013), "Anatomy and Physiology" Sports Publication, New Delhi. ISBN-978-81-7879-761-8.
8. Moore, K.L. &Agur, A.M.R. (2002), "Essential Clinical Anatomy" Second Edition by Lippincott Williams & Wilkins, Philadelphia.
9. Sharma, J.P. (2002), "Essential Encyclopedia of Human Anatomy and Physiology, by KhelSahitya Kendra, New Delhi. ISBN-81-7824-296-5.
10. Kumar, R. (2012), "Anatomy and Exercise Physiology" Sports Publication, New Delhi. ISBN-978-81-7879-697-0.
11. Singh, H. (2013), Anatomy and Exercise Physiology KhelSahitya Kendra, New Delhi. ISBN-978-81-7824-690-4.

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SEMESTER–I
PAPER- IV: NATUROPATHY
Subject Code: (PGDY CC-104)

UNIT-I

1. INTRODUCTION TO NATURE CURE

1.1 Meaning, Definition and Fundamental Principles of Naturopathy
1.2 Historical background of Naturopathy (Indian & Western)
1.3 Law of Nature/ Philosophy of Nature Cure- Panchamahabhuta Theory
1.4 Foreign Matter Theory/ Toxemia

UNIT-II

2. FASTING AND DIETETICS

2.1 Definition, Introduction and Classification of Fasting
2.2 Difference between Fasting and Starvation, Hunger and Appetite
2.3 Hygienic auxiliaries during Fasting, Physiological effect of Fasting, Methods of Breaking the fast.
2.4 Diet according to Naturopathy and its Types.

UNIT-III

3. HYDROTHERAPY AND MUD THERAPY

3.1 Introduction, Definition, Brief History, General Principles of Hydrotherapy
3.2 Physical Properties of Water and Classification of Temperature
3.3 Different Hydriatic Measures, Therapeutic Effect of Hydriatic Application
3.4 Introduction to Mud Therapy, Classification of Mud for Therapeutic use, Method of Treatment of Mud, Therapeutic Effect of Mud Therapy.

UNIT-IV

4. MANAGEMENT OF VARIOUS DISEASES WITH NATUROPATHY

4.1 Management of Obesity and Diabetes
4.2 Management of Blood Pressure
4.3 Management of Asthma
4.4 Management of Artheritisand Back Pain

REFERENCES:

1. Bakhru H. K.,The Complete Handbook Of Nature Cure,Jaico Publishing House – Mumbai,ISBN13: 9788172242299
2. Prasoon, Prof. Shrikant, PanchaMahabhutatatwa and Sharira, HINDOOLOGY BOOKS, ISBN: 9788122310115
3. Shew, Joel, (1989) Handbook of Hydrotherapy Publisher: Society of Metaphysicians Ltd; New ed of 1844 ed edition (1 January 1989), ISBN-13: 978-1852288785
4. Kellogg,John Harvey,(2004) Rational Hydrotherapy: A Manual of the Physiological and Therapeutic Effects of Hydriatic Procedures, and the Technique of their Application in the Treatment of Disease. TEACH Services, Inc. ISBN-13: 978-1572582095
5. Indani, Ashish,(2013) Mud Therapy: Healing Through One of the Five Elements , B Jain Publishers Pvt Ltd , ISBN-13: 978-8131908457
6. Ehret, Arnold, (1971) Rational Fasting, Mass Market, Benedict Lust, ISBN-13: 978-0879040055
7. Herbert M., Shelton, (1974) Fasting for Renewal of Life ISBN-13: 978-0914532385
8. Shelton, Herbert M., (2013) The Science and Fine Art of Fasting,Martino Fine Books ISBN-13: 978-1614274483

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SEMESTER-I
Yoga Practical Syllabus (PART-B)
Subject Code: (PGDY PC-101)

B-1: SYLLABUS FOR YOGA PRACTICAL - I

1. ASANAS:
   a) **Surya Namaskara**
   b) **SukshamaVyayama-**PawanMuktasana Series I, II, III
   c) **Meditative Asanas:**Padmasan, Siddhasana, Swastikasana, ArdhaPadmasana, Vajrasana
   d) **Relaxation Asanas:**Shavasana, Makarasana, ShithilaTadasana, ShithilaDandasana, Shashank Asana
   e) **Supine Asanas:**Naukasana, Kandharasana, Pavanmuktasana, Ardhamatsyasana, AnandBalasana.
   f) **Prone Lying Asanas:**Bhujangasana, Shalabhasana, Dhanurasana, Hamsasana, Santolanasana
   g) **Inversions:**Sarvangasana, Vipareetkarani asana,
   h) **Sitting Asanas:**Paschimottanasana, ArdhaMatsyendrasana, ArdhaChandrasana, ArdhaUshtrasana, Simhasana, AkarnaDhanurasana, JanuShirshasana.
   i) **Standing Asanas:**Tadasana, Natarajasana, Garudasana, Vrikshasana.
   j) **Advanced Group Asanas:**PoornaMatsyasana, Padmasarvangasana, Karnpedasana, Suptvajrasana, PoornaBhujangasana, Koormasana, Vatayasana, DwihastaBhujasana, NiralambaPaschimottanasana, Ashtavakrasana

2. PRANAYAMA:

   NadiShodhan Pranayama, Surya Bheda Pranayama, Chandra Bheda Pranayama, Ujjayi, Sheetali, Seetkari, Bhastrika, Brahmari

3. BANDHAS & MUDRAS:

   Gyana Mudra , PanchaBhautik Mudras, Jalandhar Bandha, UddiyanBandha, Vipreetkarni Mudra, Shanmukhi Mudra, Manduki Mudra, Ashwini Mudra, Kaki Mudra, Bhujangini Mudra

4. SHATKARMA:

   (a) NETI: JalNeti, Sutra Neti
   (b) DHAUTI: KunjalKriya, AgnisarKriya

5. MEDITATION TECHNIQUE: OM Meditation

6. RELAXATION TECHNIQUE: Basics of Yoga Nidra, IRT (Instant Relaxation Technique

SEMESTER-I
Naturopathy Practical (PART-B)
Subject Code: (PGDY PC-102)

B-2: NATUROPATHYPRACTICAL

Naturopathy

1. Students should be introduced to various treatment procedures used in Naturopathy.
2. Hydrotherapy and Mud Therapy
   Demonstration of various therapeutic effects, procedure and treatments in Hydrotherapy and mud therapy during practical classes.
3. Management of Diseases like Diabetes, High Blood Pressure, Asthma, Back Pain through Naturopathy.
4. Practical Record should be Maintained.
5. The Vice-Voce shall be from the complete theory syllabus of naturopahy.

SEMESTER–II

PAPER- I: PATANJALI YOGA SUTRA

Subject Code: (PGDY CC-201)

UNIT – I

1. COMPONENTS OF SAMADHI PADA

1.1 Introduction of Maharishi Patanjali, Historical background of pantanjali yoga sutras

1.2 Concept of Chitta, ChittaVriti, ChittaBhumi

1.3 Concept of Abhyasa – Vairagya, Definition & Attribute of Ishwara, Concept of IshwaraPranidhana

1.4 Yogaantaraya, ChittaVikshepsahabhuh, ChittaPrasadhana, Meaning of Samadhi, Different types of Samadhi.

UNIT – II

2. ELEMENTS OF SADHANA PADA

2.1 Kriya Yoga, PanchaKlesha, Pratiprasava

2.2 Definition of Drashta&Drishya, Tritap

2.3 Karmashaya, Haan, Hanopaya

2.4 Introduction of Ashtanga Yoga, Description of Various Limbs.

UNIT – III

3. PSYCHIC POWERS OF VIBHUTI PADA

3.1 Samyama, attainment of various Vibhooti

3.2 Kayasampata (Physical Excellence)

3.3 Manojavitvam (Mental Excellence)

3.4 VivekKhyati (Knowledge of Discrimination)

UNIT – IV

4. SAMADHI & ITS TYPES

4.1 Types of Siddhis

4.2 Concept of Dharmamegh Samadhi

4.3 Brief introduction of Karma, Types of Karma, KarmaphalSiddhanta

4.4 Concept of Kaivalya

REFERENCE:

1. Saraswati, Swami Satyanand, (2012), "Four Chapters of Freedom", Bihar School of Yoga, ISBN 13-9788185787183.
2. Iyengar, B. K. S., "Light on the Yoga Sutras of Patanjali", Haper Collins Publications India Pvt. Ltd., New Delhi, ISBN 13-9788172235420.
3. Swami, Satchidananda, "The Yoga Sutras of Patanjali", Integral Publications, U.S.A., ISBN 13-9781938477072.
4. Taimini, Science of Yoga, ISBN 13-9788170592112.
5. Swami,Vivekananda, "Raja Yoga", ISBN 13-978100746940.
6. Mishra, Vachaspati, "Yoga Sutra (TatvaVaishardi)", ISBN 13-9780404578046.
7. Shastri, Vijaypal, "Yoga SurtaVimarsh", ISBN 13-9780865477360.
8. Lakshmananand, "Yoga Prakash", ISBN 13-9788175971240.
9. Suresh Chandra Shrivastava, Patanjali Yoga Darshan
10. Ram Prasad, Patanjali Yoga Sutra.
11. T.S. Rukmani, Vol.I-IV, Patanjali Yoga Sutras.
12. Baron, R.A. (2007). Psychology (Fifth edition) New Delhi: Pearson Prentice-Hall of India.
13. Clifford T. Morgan, Richard a. King, John R. Weis and John Schopler (1993), "Introduction to Psychology" – 7th Edition. Tata McGraw Hill Book Co. New Delhi.
14. Shanti PrakashAtrey, "Yoga Manovigyan".
15. R.S. Bhoghal, "Yoga & Mental Health".
16. R.S. Bhoghal, "Yoga evamMansikSwasthya".
17. Prof. Ramharsh Singh, "AyurvediyaManasVigyan".
18. Prof. Suresh LalBaranwal, "Yoga evamMansikSwasthya".

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SEMESTER–II
PAPER- II : ARHAM YOGA
Subject Code: (PGDY CC-202)

UNITI

ArhamDhyanYog

Antiquity ofJainYoga, Various dimensions ofJainYoga, KarmaSoul and Arhamyoga, IntroductionToTheAshtangasofYoga, YogabyAcharyaPujyapadLimbs of yogby ShriVeersenAcharyaMeaning of Arhammantra.

UNITII

MethodandBenefits

PanchParmeshthi Arham-FiveStepsProcess, Panch mudra in detail Spiritualyōga, ArhamMantraPower, Trayaśuddhi:triadpurification,PositiveAffirmations,

UNITIII

Pranayam

Prāṇa ,TypesofPrāṇa,Lifeexpectancyandrespiration, TypesofPrāṇāyāma, śvāsōcchvāsa, Types ofbreath

UNIT IV

ArhamAshtangYog

8limbsofMeditation, 8limbsofmeditation, GoalofMeditation-Dhyey, Place, time and Method of meditation,

UNIT V

Theoreticalandscientificanalysis

HowistheMind?, Do's and Don'ts, Diet, śākabhuk-VegetarianFood,Healthyfood,Quanttyoffood, Aftermealwalk

REFERENCES:

1. Rao, V. Manglagowri (2007), "The Text Book of Swasthavritta", ChaukhambhaOrientalia, Varanasi, 97881-7637-034-9.
2. CharakSamhita (1st part), Choukhambha Sanskrit Sansthan, Varanasi, ISBN 81-7080-014-5, 1994.
3. SushrutSamhita (Sutra sthan and Sharirsthan), ChoukhambhaOrientila, ISBN 978-0199360079.
5. AshtangaHradayam (Sutra sthan), Choukhambha Sanskrit Sansthan, Varanasi, ISBN 10:8121800226.
6. Swami, ShivanandaSaraswati, (1957) "Yoga Therapy, Umachal Yoga Ashram, Guwahati".
7. Verma, Janki Prasad, (1962), "Rogo Ki achukeChikitsa" Leader Press, Allahabad
8. Yogeshwar, "Simple Yoga Therapy", Yoga Center, Madras.
9. Tiwari, O. P., (1984), "Asanas–Why and How", Kaivalayadhama, Lonavala.
10. Kuvalayananda Swami, (1993), "Asanas", Popular Prakashan, Kaivalayadhama, Lonavala.
11. Sharma VishwamitraAacharya, "SachitraYogasanAurSwasthya", ManojPrakashan, Delhi.

PAPER-III: PRINCIPLES OFPSYCHOLOGY AND COUNSELING
Subject Code: (PGDY CC-203)

UNIT-I

1. INTRODUCTION TO PSYCHOLOGY

1.1 Definition, meaning and scope of Psychology
1.2 Branches of Psychology
1.3 Relevance and Contribution of Psychology in Teaching and Learning Process of Yoga Education
1.4 Different Methods of Psychology (Introspection, Observation, Experimental, Survey, Clinical)

UNIT-II

2. CONCEPT OF PERSONALITY

2.1 Indian and Western approach to personality.
2.2 Theories of personalities.
2.3 Personality Test (Big Five).
2.4 Attitude change though Yoga & Developing Yogic Personality.

UNIT-III

3. PSYCHOLOGY AND YOGA

3.1 Introduction to Psychological and Transcendental perspective of Yoga.
3.2 Meaning and Characteristics of Mental Health.
3.3 Mental Relaxation through Prayer, A cross cultural approach to Mental Health.
3.4 Yogic Life Style for Stress, Anxiety and Depression.

UNIT-IV

4. INTRODUCTION TO GUIDANCE COUNSELING

4.1 Need, Meaning and Importance of Guidance and Counseling in Yoga Education
4.2 Different Types of Counseling: (Individual and Group counseling).
4.3 Approaches of Counseling: Directive, Non directive, Techniques in Counseling: (Testing and Non Testing Techniques).
4.4 Yoga Meditation: Metaphysical and Therapeutic Perspective

REFERENCES:

1. Baron, R.A. (2007). Psychology (Fifth edition) New Delhi: Pearson Prentice-Hall of India.
2. Baron.A. Robert, Psychology, Pearson Education Vth Ed.,2002.
3. Chaplin, P., &Kraweic, T.S. (1974). System and Theories in Psychology. New York: Holt, Rinehart & Winston.
4. Clifford T. Morgan, Richard a. King, John R. Weis and John Schopler,"Introduction to Psychology" – 7th Edition. Tata McGraw Hill Book Co. New Delhi, 1993.
5. Edward, E. S., & Stephen, M.K. (2007). Cognitive Psychology: Mind and Brain. New Jersey: Prentice Hall India.
6. Ernest R. Hillgard, Richard C. Atkinson, Rita L. Atkinson, "Introduction to Psychology" 6th Edition, Oxford IBH publishing Co. Pvt. Ltd., New Delhi,1975.
7. Marx, M.H. &Hillix, W.A. (1987). Systems and Theories in Psychology. New York: McGraw Hill.
8. Schultz, D. (1985). A History of Modern Psychology. New York: Academic Press.
9. Wolman, B.H. (1973). Handbook of Psychology. New Jersey: Prentice Hall.
10. Woodworth, R., & Schlosberg, (1976). Experimental Psychology. New York: Holt and Rinehart.
11. Shanti PrakashAtrey, "Yoga Manovigyan".
12. R.S. Bhoghal, "Yoga & Mental Health".
13. R.S. Bhoghal, "Yoga evamMansikSwasthya".
14. Prof. Ramharsh Singh, "AyurvediyaManasVigyan".
15. Prof. Suresh LalBaranwal, "Yoga evamMansikSwasthya".

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SEMESTER–II
PAPER-IV: ALTERNATE THERAPY
Subject Code: (PGDY CC-204)

UNIT-I

1. INTRODUCTION TO ALTERNATE THERAPIES

1.1 Introduction to alternate therapies and Types of Alternate therapies
1.2 Historical background and development of alternate therapies all around the world
1.3 Comparative study of Alternate therapies with other systems of medicine
1.4 Need of Alternate Therapies in the present times

UNIT-II

2. MANIPULATIVE THERAPIES & PHYSICAL BODY

2.1 AccupressureandAccupuncture – Introduction and basic principles
2.2 Reflexology andSujok – Concept and fundamentals of their functioning
2.3 Magnetotherapy- Principles of Magnetotherapyand its application
2.4 Massage Therapy & its benefits

UNIT-III

3. INTRODUCTION TO AYURVEDA, COLOUR & AROMATHERAPY

3.1 Ayurveda – Concept of Ayurveda and its role in healthy living
3.2 Panchkarma- Process and Benefits
3.3 Colourtherapy and spectrum of colours
3.4 Aromatherapy – Basic principles of Aromatherapy and its role in relaxation

UNIT-IV

4. PSYCHO-SPIRITUAL THERAPIES

4.1 Pranic Healing Methods and its application
4.2 Reiki – Introduction, concept and laws of Reiki healing
4.3 Hypnotherapy – Concept of Hypnotherapy
4.4 Introduction to Astrology and Religious Beliefs

REFERENCES:

1. Freeman PhD, Lyn W, "Mosby's Complementary & Alternative Medicine: A Research-Based Approach", Publisher: Mosby; 3rd (third) edition, ASIN: B00BT03ABG
2. Micozzi MD,Marc S.PhD, (January 1, 2015), "Fundamentals of Complementary and Alternative Medicine", (Publisher: Saunders; 5 edition, ISBN-13: 978-1455774074
3. Coghill, Roger, (9 November 2000) "The Book of magnetic healing", Publisher: Fireside, ISBN-13: 978-0684869674
4. Birla, Ghanshyam Das and Hemlin, Colette, "Magnet Therapy",Healing Arts Press, ISBN 9780892818419.
5. Lee, Jonathan and taylor, (May 1, 2004), "Lesley Color Therapy", Publisher: Sterling ISBN-13: 978-1402710117
6. Gimbel, Theo. (April 1, 2005), "Healing with color", Publisher: Gaia ISBN-13: 978-1856752220
7. Walker, Dr. Marton (November 1, 1990), "The Power of color", Publisher: Avery ISBN-13: 978-0895294302
8. Gala, Dr. D. R .and Gala, DR. Dhiren, Gala, DR. Sanjay : (31 December 2000): " Be your own doctor with Acupressure", Bombay, Navneet Publications. Publisher: Navneet Publications ISBN-13: 978-8124301395
9. Singh, Attar , (1995) "Acupressure (Hindi) Paperback" –Publisher: ACS; 1 edition ASIN: B01F0XEN9A
10. Kellogg, John Harvey (1996-04-01). "Art of Massage: A Practical Manual for the Nurse, the Student and the Practitioner" Kessinger Publishing, LLC. ISBN 1-56459-936-1.
11. Horan, Paula, (2016), "Abundance Through Reiki", MotilalBanarsidas 2nd Editions, ISBN-13:978-8120814776.
12. Horan, Paula, (1995), "Empowerment through Reiki", Lotus Press 8th Editions, ISBN-13:978-0941524841
13. Elman, Dave, (1994), "Hypnotherapy", Westwood Publishing Company, U.S., ISBN-13:978-0930298043
14. Murphy, Dr. Joseph, (2015) "Power of Your Subconscious Mind", Amazing Reads, ISBN 13:978-8192910963
15. Charak, Dr. K.S., (2002), "Elements of Vedic Astrology", Uma Publications, ISBN 13:978-8190100809
16. Co, Mater Stephen, Robins M.D. Eric-B., Merryman, John, (2004), "Your Hands Can Meal Yon", Atria Books, ISBN 13: 978-0743243056.

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SEMESTER-II
Yoga Practical Syllabus (PART-B)
Subject Code: (PGDY PC-201)

B-1: SYLLABUS FOR YOGA PRACTICAL - II

1. ASANAS:
   i) **Surya Namaskara**
   ii) **SukshamaVyayama by DheerendraBrahmachari**
   iii) **Meditative Asanas:**Guptasana, Vajrasana, Bhadrasana
   iv) **Relaxation Asanas:** Balasana, Shashankasana
   v) **Supine Asanas:**Halasana, Chakrasana, Markatasana, Setubandhasana , Suptabaddhakonasana
   vi) **Prone Lying Asanas:** Sarpasana , VipreetaNaukasana, Dhanurasana, Shalabhasana
   vii) **Sitting Asanas:**Vyaghrasana, Mandukasana, Bakdhyanasana, Gomukhasana, Marichyasana I, Rajkapotasana, Bharadwajasana
   viii) **Standing Asanas:** Trikonasana, Ardha Kati Chakrasana, Veerbhadrasana (I &II)
   ix) **Inversion Asanas:** Sarvangasana, Sirshasana, Salambasirshasana
   x) **Advanced Group Asanas:** PadaAngusthasana, Garbhasana, Baddhpadmasana, Kukkutasana, Bakasana, Hanumanasana, Kurmasana, UttanaKurmasana, Tittibhasana, Mayurasana, Padma Mayurasana

2. **PRANAYAM:**Ashtakumbhaka of Hatha Yoga Pradipika

3. **BANDHAS & MUDRAS:** MoolaBandha, MahaBandha, VipareetKarani Mudra, Khechari Mudra, Tadagi Mudra, Pashinee Mudra, , Maha Mudra, MahaBheda Mudra

4. **SHATKARMA:** Kapalbhati Three Types (Vyutkarma, SheetkarmaandVaatkarma), Nauli, Trataka, DandaDhauti, VastraDhauti

5. **MEDITATION TECHNIQUES:** SohamDhyan, SavitaDhyan
6. **RELEXATION TECHNIQUE:** Yoga Nidra (advance)

SEMESTER-II
Alternate Therapies Practical / Viva Voce Syllabus (PART-B)
Subject Code: (PGDY PC-202)

B-2 ALTERNATE THERAPY PRACTICAL

Alternate Therapies

1. Practice of Massage Therapy and its application.
2. Concept of Sujok and Demonstration of basic Accupressure Points and Reflexology
3. Magnetotherapy- Basic Instruments & method of working
4. Case Study Record should be maintained separately at least 5 person, practical record books should be maintained.
5. Viva Voce based on the Theory Paper of Alternate Therapies.

INTERNAL ASSESSMENT CRITERIA
(P.G. Diploma in Yoga Education)

Internal Assessment for all subjects in P.G. Diploma in Yoga Education will be done as follows:

(1)	Assessment within Class	:	(10)
(2)	Class Test	:	(05)
(3)	Assignement	:	(05)
(4)	Attendance*	:	(05)
(6)	Total	:	(25)

NOTE: *Criteria for giving marks of attendance

% of Attendance	Marks
50%	1
60%	2
70%	3
75%	4
80%	5
85%	6
90%	7
94%	8
97%	9
100%	10