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BUILDING MATERIALS & CONSTRUCTION (ESC 302)

LTPC 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.

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

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.

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ENVIRONMENT AND ECOLOGY (MC 301/ MC 401) L T P C-2 0 0 0

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.

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.

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.

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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.

ESTIMATING & COSTING BCE-403

Course Outcome

L T P C
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

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.

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

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.

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.			

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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			

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.			

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			

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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.			

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			

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.			

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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			

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			

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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			

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.			

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

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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.			

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			

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.			

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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.

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.

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

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.

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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.			

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.			

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.			

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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.			

OEC	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.			

Non-Conventional Energy Resources (OE-ME 701)

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.

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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.

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VISION & MISSION OF CIVIL ENGINEERING DEPARTMENT FOR NEXT DECADE

Vision of the Institution: To be a leading Institute offering quality technical education, research and preparing technocrats with applicable knowledge for meeting or fulfilling the needs of the industry and society.

The vision of a department is to prepare students to become highly skilled and innovative civil engineers who can meet the needs of society and make a positive impact on the world.

Education: The civil engineering department aims to provide a high-quality education that prepares students for successful careers in civil engineering. This may include a focus on developing technical skills, as well as soft skills like communication, teamwork, and problem-solving.

Research: The department aims to conduct cutting-edge research that enhances the field of civil engineering and addresses important societal challenges. This research may include topics like sustainability, resilience, and infrastructure design.

Community engagement: The civil engineering department aims to prioritize community engagement, seeking to work with local communities to understand their needs and develop infrastructure that serves them effectively.

Global perspective: Civil engineering is a global field, and the department aims to provide students with a global perspective on engineering challenges and solutions. This may include study abroad opportunities, collaborations with international partners, and a focus on addressing global challenges like climate change.

Overall, the vision of a civil engineering department is to provide students with the education, skills, and perspective they need to become successful and impactful civil engineers who can meet the needs of society and make a positive contribution to the world.

Mission of the Institution:

M1: To introduce quality programmes with an updated curriculum in the thrust area of the technology.
M2: To provide the state-of-the-art infrastructure and employ competent and committed human resource for carrying out teaching and research.
M3: To create and nurture a conducive environment for teaching-learning using modern tools, research and critical thinking.
M4: To produce technocrats and entrepreneurs who are responsible and are adaptable towards the changing needs of industry.

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Program outcomes suggested by the NBA for engineering programs

Program Outcomes (POs), are attributes acquired by the student at the time of graduation. The POs given in the Table below, ensure that the POs are aligned to the Graduate Attributes (GAs) specified by National Board of Accreditation (NBA). These attributes are measured at the time of Graduation, and hence computed every year for the outgoing Batch. The POs are addressed and attained through the Course Outcomes (COs) of various courses of the curriculum.

PO1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Problem analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. 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.

PO4. 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.

PO5. 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.

PO6. 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.

PO7. 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.

PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. Communication: Communicate effectively on complex engineering activities with the engineering community and with the 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.

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PO11. Project management and finance: Demonstrate knowledge 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.

PO12. 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.

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Department of Civil Engineering

Vision of the Department:

To become a centre of excellence in the field of Civil 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 Civil & Environment Engineering by subsuming theory with extensive practical training and exposure to construction 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 Civil Engineering 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: Attain the analytical expertise to create, analyse, formulate, and solve challenging problems in the field of Civil Engineering; and recognize and develop the necessary and suitable tools for the same.

PEO 2: Develop technical and management flair to take responsibility for engineering projects and research programs significantly.

PEO 3: Uncover multidisciplinary approach and co-relate engineering issues to social and human background in broader sense, in which their engineering helping hand will be utilised.

Program Specific Outcomes

PSO1: 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.

PSO2: Execute the construction of buildings and other components of various projects in Civil Engineering including its layout, management, and quality control.

PS03: Implement the provisions made in Indian Standard Codes/ other relevant codes/ specifications/ guidelines and applicable laws including labour laws and environmental laws.

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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

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Department of Computer Science and Engineering

	Programme Outcomes(POs)	Graduate Attributes (GAs)
PO1.	Apply the knowledge of mathematics, science, engineering fundamentals, and Engineering concepts for the solution of complex Engineering problems	Engineering Knowledge
PO2.	Identify, formulate, review the literature and analyze complex problems related to computer science and engineering reaching substantiated conclusions using the first principles of mathematics and engineering sciences.	Problem Analysis
PO3.	Design solutions for complex problems in mechanical engineering 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	Design/Development of solutions
PO4.	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.	Conduct Investigations of complex problems
PO5.	Create, select, and apply appropriate techniques, resources, and modern engineering tools such as optimization techniques, simulations, including prediction and modeling to complex process engineering problems with an understanding of their limitations.	Modern Tool Usage
PO6.	Apply contextual knowledge with justification to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to engineering and computer science and engineering professional practice	The Engineer & Society
PO7.	Environment and sustainability: An ability to understand the principles, commitment and practice to improve product sustainable development globally in computer science and engineering with minimal environmental effect.	Environment and Sustainability

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PO8.	Apply ethical principles and commit to professional ethics adhering to the norms of the computer science engineering practice	Ethics
PO9.	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings	Communication

Yellow color represents the text highlighted for Local,National, and Regional Needs

Cyan color represents the text highlighted for Global Needs

PO10.	Communicate effectively on complex engineering and computer science and 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	Individual and Team work
PO11.	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	Lifelong Learning
PO12.	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 computer science and engineering projects and in multi disciplinary environments.	Project management &Finance

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Institute of Engineering and Technology

Director

Department of computer and science engineering

Program Specific Outcomes(PSOs)

PSO1: To apply computer science and engineering knowledge to identify and solve the real life problems

PSO2: To enhance technical capabilities, entrepreneurship quality and awareness of latest trends in computer science and engineering discipline

PSO3: To develop the computer based system in logical manner using various algorithms and programming.

Yellow color represents the text highlighted for Local,National, and Regional Needs

Cyan color represents the text highlighted for Global Needs

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BCS-301	Database Management System	3L-T-2P	CREDIT -4

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

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.

BEC 301	Digital Electronics	3L-1T-2P	CREDIT -4

Objectives of the course:

At the end of this course, students will demonstrate the ability to

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PO10.	Communicate effectively on complex engineering and computer science and 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	Individual and Team work
PO11.	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	Lifelong Learning
PO12.	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 computer science and engineering projects and in multi disciplinary environments.	Project management &Finance

Department of computer and science engineering

Program Specific Outcomes(PSOs)

PSO1: To apply computer science and engineering knowledge to identify and solve the real life problems

PSO2: To enhance technical capabilities, entrepreneurship quality and awareness of latest trends in computer science and engineering discipline

PSO3: To develop the computer based system in logical manner using various algorithms and programming.

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

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

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.

BCS 403	Design and Analysis of Algorithms	3L-1T-4P	CREDIT -4

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.

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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..

BCS-401	**Computer Organization**	**3L-1T-0P**	**CREDIT -4**

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.

BCS403	**Discrete Mathematics**	**3L-1T-0P**	**CREDIT -4**

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.

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

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.

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

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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

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.

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

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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.

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.

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)

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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. (Unders

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 com

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.

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CO5 1. Analyze the internal architecture and real time control of 8051.

2. Analyze the internal architecture of ARM Processors.

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.

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.

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:

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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 perceprtron 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

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

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.

Cryptography and Network Security

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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 secur

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.
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:

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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

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

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.

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CO3. Execute scan line polygon filling

CO4 Implement basic transformations on objects

CO5 Implement clipping algorithm on lines

DATA MINING AND DATA WAREHOUSE

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.

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

DECS 601	Advance Computer architecture	3L-1T-P	CREDIT -4

Course outcome expected:

By end of this course the student should be able to

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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

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.

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

Parallel Depth-First Search, Parallel Best-First Search, Speedup Anomalies in Parallel Search Algorithms

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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.

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.

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.

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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

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

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.

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

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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 .

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.
CO2. 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.

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.

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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.

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.

Data science

OE-CS 701	Data science	3L-0T-0P	CREDIT -4

Course outcomes Expected

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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.

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).

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.

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Subject Code

NEP-CS-001	Python
NEP-CS-002	Cyber Security
NEP-CS-003	Basics of Computer Fundamentals
NEP-CS-004	C Programming

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Value Added Course CSE- 7th Sem

Course Name	Python
Course Code	NEP-CS-001
Duration	30hrs
Resource Person	Er. Aditi Gupta
Organised by	Department of CSE, IET Agra

About the Course: Python is a popular general-purpose programming language. It is used in machine learning, web development, desktop applications, and many other fields. Fortunately for beginners, Python has a simple, easy-to-use syntax. This makes Python a great language to learn for beginners. In this course, participant will get exposure to concept of data structure, function, arrays and other programming concept.

Course Objective: The main objective of this course is to build basic programs using fundamental programming constructs like variables, conditional logic, looping, and functions. Work with user input to create fun and interactive programs.

Course outcome expected:

By end of this course the student should be able to

CO1: Create a software application using the Python programming language.

CO2: Debug a software application written in the Python programming language.

CO3: Test a software application written in the Python programming language.

CO4: Read, write and understand code written in python.

CO5: To understand the functions of Application in python language.

SYLLABUS

Unit -I (6hrs)
General Introduction: Programs and Algorithm, Introduction to Python, Introduction to Debugging. Simple Python: Variables, Expression, and Statement, Values and Data types, Statement and Expression, Operators, Input and Output, Debugging Interlude: Avoid Debugging, Beginning Tips, Error Message
Python Turtle Graphics: Instances, The for loop, Flow of Executions Iteration and the Range Functions
Python Module: Modules and Getting Help, The math module, The random module

Unit-II (6hrs)
Function: Functions, Unit Testing, Local Variables and Parameters, The Accumulator Pattern, Nesting Functions, Flow of Execution, Using the main function Program Development
Selection: Boolean Values and Expressions, Operators and Precedence of Operations, Conditional Execution, Nesting and Chaining Conditionals
Iteration: The for loop revisited, while statement, Applications and Patterns, Sentinels and Input Validation, Algorithms Revisited

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Value Added Course C.SE Sem-5 Sem

Course Name	Cyber Security
Course Code	NEP-CS-002
Duration	30hrs
Resource Person	Er. Saurabh Garg
Organised by	Department of CSE, IET Agra

About the Course: Cybersecurity is a highly competitive field that can be extremely rewarding for those with the right set of skills. All in all, a career in Cybersecurity is an excellent choice for individuals who have great communication and problem-solving skills. In this course, participant will get exposure to concept of Internet security, cyber attacks and rule for using internet safely.

Course Objective: The main objective of this course is to ensure a risk-free and secure environment for keeping the data, network and devices guarded against cyber threats.

Course outcome expected:

By end of this course the student should be able to

CO1 To understand the concept of Cyber security and issues and challenges associated with it.

CO2 To understand the cyber- crimes, their nature, legal remedies and as to how report the crimes

CO3 To understand the basic concepts related to E-Commerce and digital payments security.

CO4. To appreciate various privacy and security concerns on online Social media and understand the reporting procedure of inappropriate content.

SYLLABUS

Unit -I (6hrs)

Introduction to Cyber Security: Defining Cyberspace and Overview of Computer and Web-technology, Architecture of cyberspace, Communication and web technology, Internet, World wide web, Advent of internet, Internet infrastructure for data transfer and governance, Internet society, Regulation of cyberspace, Concept of cyber security, Issues and challenges of cyber security

UNIT - II (6hrs)

Cyber Crime an Cyber Law: Classification of cyber-crimes, Common cyber-crimes- cyber-crime targeting computers and mobiles, cyber-crime against women and children, financial frauds, social engineering attacks, malware and ransomware attacks, zero day and zero click attacks, Cybercriminals modus-operandi, Reporting of cyber-crimes, Remedial and mitigation measures, Legal perspective of cyber-crime, IT Act 2000 and its amendments, Cyber-crime and offences, Organizations dealing with Cyber-crime and Cyber security in India, Case studies.

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Value Added Course CSE - 1st sem

Course Name	Basic of Computer Fundamentals
Course Code	NEP-CS-003
Duration	30hrs
Resource Person	Er. Subodh Sharma
Organised by	Department of CSE, IET Agra

About the Course: This course deals with fundamentals of computer. Which includes generations of computer, evolution and development of microprocessor, input and output devices, primary and secondary storage devices, programming languages etc.

Course Objective: The main objective of this course is to understand basics of computer and working with OS. To develop working skills with productivity tools, graphics designing and Internet. To acquire basic programming skills.

Course outcome expected:

By end of this course the student should be able to

CO1: To understand fundamentals of computer and its peripherals devices

CO2: To understand operating system and user interface

CO3: To understand and work with MS Word and spreadsheet

CO4: To understand world wide web and Internet

SYLLABUS

Unit I (6hrs)

Introduction: Knowing computer: What is Computer, Basic Applications of Computer; Components of Computer System, Central Processing Unit (CPU), VDU, Keyboard and Mouse, Other input/output Devices, Computer Memory, Concepts of Hardware and Software; Concept of Computing, Data and Information; Applications of IECT; Connecting keyboard, mouse, monitor and printer to CPU and checking power supply.

Unit – II (6hrs)

Operating Computer using GUI Based Operating System: What is an Operating System; Basics of Popular Operating Systems; The User Interface, Using Mouse; Using right Button of the Mouse and Moving Icons on the screen, Use of Common Icons, Status Bar, Using Menu and Menu-selection, Running an Application, Viewing of File, Folders and Directories, Creating and Renaming of files and folders, Opening and closing of different Windows, Basics of O.S Setup; Common utilities

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Value Added Course CSE – III[rd] Sem

Course Name	C Programming
Course Code	NEP-CS-004
Duration	30hrs
Resource Person	Er. Prashant Maharishi
Organised by	Department of CSE, IET Agra

About the Course: C programming language is a general-purpose, procedural, high-level programming language used to develop computer software, computer applications, system programming, game development, web development, and more.

Course Objective: The major objective is to provide students with understanding of code organization and functional hierarchical decomposition with using complex data types. Learn and debug c language programs.

Course outcome expected:

By end of this course the student should be able to

CO1: Create a software application using the C programming language.

CO2: Debug a software application written in the C programming language.

CO3: Test a software application written in the C programming language.

CO4: Read, write and understand code written in C language.

SYLLABUS

Unit -I (6hrs)

General Introduction: Introduction, Art of Programming through Algorithms and Flowcharts History and importance of C, Basic structure of C program, executing a C program.
Constants, Variable and Data Types: Introduction, Character Set, C Tokens, Keywords and Identifiers, Constants, Variables, Data Types, Declaration of Variables, Assigning Values to Variables, Defining Symbolic Constants

Unit-II (6hrs)

Operators and Expressions: Introduction, Arithmetic Operators, Relational Operators, Logical Operators, Assignment Operators, Increment and Decrement Operators, Conditional Operator, Bitwise Operators, Special Operators, Arithmetic Expressions, Evaluation of Expressions, Precedence of 08 L1, L2 Arithmetic Operators, Type Conversions in Expressions
Decision Making and Branching: Introduction, Decision Making with IF Statement, Simple IF Statement, the IF-ELSE Statement, Nesting of IF-ELSE Statements, The ELSE IF Ladder, The Switch statement

Unit - III (6hrs)

Arrays: One-dimensional Arrays, Declaration of One-dimensional Arrays, Initialization of One-dimensional Arrays, Example programs- Bubble sort, Selection sort, Linear search, Binary search, Two-dimensional Arrays, Declaration of Two-dimensional Arrays, Initialization of Two-dimensional Arrays.

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Value added Courses in ECE Department

1. Human Values & Professional Ethics	ECE 3rd semester
2. Environment and Ecology	ECE 4th Semester
3. Occupational Health & Safety	ECE 6th Semester
4. Python Programming Lab	ECE 7th Semester

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Program outcomes suggested by the NBA for engineering programs

Program Outcomes (POs), are attributes acquired by the student at the time of graduation. The POs given in the Table below, ensure that the POs are aligned to the Graduate Attributes (GAs) specified by National Board of Accreditation (NBA). These attributes are measured at the time of Graduation, and hence computed every year for the outgoing Batch. The POs are addressed and attained through the Course Outcomes (COs) of various courses of the curriculum.

PO1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Problem analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. 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.

PO4. 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.

PO5. 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.

PO6. 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.

PO7. 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.

PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. Communication: Communicate effectively on complex engineering activities with the engineering community and with the 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.

PO11. Project management and finance: Demonstrate knowledge 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.

PO12. 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.

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BCS-301 Mathematics III

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.

BEC 301 Digital Electronics

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.

BEC 351 Digital Electronics Lab

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.

BEC 302 Electronic Devices & Circuits

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.

BEC 352 Electronic Devices & Circuits Lab

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.

BEE 301 Network Analysis & Synthesis

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.

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BCS 301 Data structure

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.

BCS 352 Data Structures Lab

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.

MC 302/MC 402 Human Values & Professional Ethics

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.

BEC-401 Electromagnetic Theory

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.

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BEC 402 Microprocessors and its Applications

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.

BEC 452 Microprocessor and its Applications Lab

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.

BEC 403 Signals and Systems

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.

BCS 404 JAVA

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

BCS 454 JAVA Lab

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)

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BEC451 PCB Design Lab

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

BHSM 501 Economics for Industry

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

BEC 501 Antenna & Wave Propagation

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.

BEC 502 Automatic Control Systems

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

BEC 503 Electronic Measurement & Instrumentation

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.

BEC 553 Electronic Measurement & Instrumentation Lab

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.

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DE-ECE 501 Electrical Engineering Materials

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.

OEC 503 Laser Systems and its Application

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

BEC 601 Analog Communications

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.

BEC 651 Analog Communications Lab

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

BEC 602 Digital Signal Processing

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.

BEC 652 Digital Signal Processing Lab

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.

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BEC 603 Linear Integrated Circuits

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.

BEC 653 Linear Integrated Circuits Lab

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.

OHS 601 Occupational Health & Safety

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

DE-ECE 601 Power Electronics

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.

DE-ECE 605 Computer Networks

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.

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OEC 603 Robotics

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.

BEC 701 Digital Communications

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.

BEC 751 Digital Communications Lab

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.

BEC 702 Wireless & Mobile Communication

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.

BEC 752 Wireless & Mobile Communication Lab

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.

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DE-ECE 701 VLSI

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 the Sequential MOS logic circuit.
5. Students are able to analyze circuits using both analytical and CAD tools.

OEC 711 Machine learning and Python Programming

Course Outcomes: At the end of this course students will demonstrate the ability to

1. Do programming with Python
2. Apply Statistics to machine learning and know how it is different than descriptive statistics
3. Build features that meet analysis needs and understand different approaches for creating predictive models
4. Create and evaluate data clusters
5. Apply Python for NLP

BEC 801 Optical Communications

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.

BEC 851 Optical Communications Lab

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

BEC 802 Satellite Communication

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.

DE-ECE 805 Fuzzy Logic and Neural Network

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.

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OEC 803 Advance Sensors and Transducers

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.

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Electrical Engineering Department

VISION

- To produce competent Electrical Engineers by imparting quality education and make them industry ready to serve the society

MISSION

- To nurture a conducive academic environment to offer quality Education in Electrical Engineering
- To develop and maintain appropriate facilities for promoting research and innovation for sustainable development
- To develop overall personality of students by instilling in them social responsibility and leadership qualities

Programme Educational Objectives (PEOs)

The Program Educational Objectives (PEOs) for the **Electrical Engineering** program describe accomplishments that graduates are expected to attain within five to seven years after graduation

PEO – 1: To provide students with strong fundamentals concepts and also advanced tools and techniques to enable the graduates build solutions or systems of varying complexity.

PEO – 2: To enable graduates to pursue research, have a successful career in academia or industries associated with Electrical Engineering

PEO – 3: To prepare students as entrepreneurs capable of delivering ethical, innovative and sustainable solutions to the problems identified.

Programme Specific Outcome (PSOs)

After the successful completion of B.E. programme in Electrical Engineering, the graduates will be able to

PSO – 1: Analyze and design electrical machines and power converters

PSO – 2: Implement and maintain computerized solutions in Power and Energy sectors.

PSO – 3: Implement AI and Automation to solve problems Industry and Society

PSO – 4: Design and develop Renewable Energy Solutions and Electrified Automobiles

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III Semester

BCS-301 Mathematics III

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.

BEE 301 Network Analysis & Synthesis

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.

BEE 302 Electrical Machines I

Course Outcomes: At the end of this course students will demonstrate the ability to

1. Understand the principle of Electromechanical Conversion of Energy in electrical machines
2. Understand how the DC Generators and DC Motors operate and also their characteristics and applications
3. Apply mathematical models of the machines to design, test and analyze the performance of DC Machines
4. Understand the starting methods and apply their knowledge to control speed of DC Machines and
5. Analyze the performance of single phase and three phase transformers

BEE 303 Solid State Devices & Circuits

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.

BEC 301 Digital Electronics

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

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problem.

4. Understand and implement various digital integrated circuits using different logic families and simple systems composed of PLDs.

MC 302/MC 402 Human Values & Professional Ethics

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.

BEC 351 Digital Electronics Lab

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.

BEE 352 Electrical Machines Lab – I

Course Outcomes: On successful completion of the course, the student will be able to

CO1 To experiment with the shunt and compound D.C. Generators and obtain their performance characteristics

CO2 To perform load tests on D.C. Motors and analyze their performance characteristics

CO3 To conduct tests on single phase transformers and predict and analyze their performance

BEE 352 Solid State Devices & Circuits Lab

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.

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IV Semester

BEE 401 Electrical Measurements and Instruments

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.

BEC 402 Linear Integrated Circuits

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.

BEE 402 Electrical Machines – II

Course Outcomes: At the end of this course students will demonstrate the ability to

1. Understand the principle of Synchronous Generators and Motors and their characteristics and applications
2. Apply mathematical models of the Synchronous machines to design, test and analyze their performance
3. Understand the operation of three phase Induction motors and analyze their performance.
4. Apply mathematical models of the Single phase induction Motors to test and analyze their performance
5. Aware of the working principle of special AC and DC motors and their applications.

BEE-403 Electromagnetic Theory

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.

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BCS 402 Data structures and Algorithms

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.

MC 401 Environment and Ecology

Same as CSE and ECE

BEE 451 Electrical Measurements & Instrumentation Lab

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.

BEC 452 Linear Integrated Circuits Lab

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_0=500H.
5. know about timer-555 operation as monostable and astable multivibrator.

BEE 452 Electrical Machines Lab II

On successful completion of the course, the student will be able to

CO1 To demonstrate some methods of starting and speed control of an Induction Motor

CO2 To operate a synchronous motor and demonstrate the effect of excitation on its performance

CO3 To conduct various tests on an Alternator and analyze the performance

CO4 To conduct various tests on a single phase Induction motor and analyze its performance

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BCS 452 Data Structures and Algorithm Lab

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.

V Semester

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	

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	

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	

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	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.

HSMC-501 Economics for Industry L-T-P-C: 3-0-0-3 Common to all

Same as ECE/CSE

DEEE 502 Introduction to Power Plant Engineering

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.

OEEE 501 VLSI Circuits

OEEE-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	

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BEE 551 Power Systems I Lab

Course Outcomes: At the end of this course students will demonstrate the ability to

1. Calculate the various parameters of transmission lines using MATLAB.
2. Analyze the design of various components of distribution system.

BEE 552 Electronic Design Lab

Course Outcomes: At the end of this course students will demonstrate the ability to

1. Study using MATLAB various Electrical circuits for combinations of R, L, C, and AC or DC sources.
2. Study using MATLAB various Electronic circuits using diode, transistors and OPAMP.

BEE 553 Microprocessor and Microcontrollers Lab

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

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VI SEMESTER

BEE601 Power Systems II

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	

BEE602 Automatic Control Systems

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	

BEE603 Power Electronics

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	Demostrate 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.	

MC601 Occupational Health and Safety

Same as ECE, CSE

DEEE601 Soft Computing

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.	

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DEEE 701 **1 Electrical and Hybrid Vehicles**

OEEE-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	

VI SEMESTER

BEE651 Power Electronics and Drives Lab

Course Outcomes: At the end of this course students will demonstrate the ability to

3. Correlate theoretical and practical analysis of AC-AC, DC-AC converters and also converter fed to AC&DC drives.
4. Analyze the characteristics of MOSFET, SCR and SCR firing circuits

BEE652 Automatic Control Systems Lab

Course Outcomes: At the end of this course students will demonstrate the ability to

1. Demonstrate and analysis various controllers like, PID, Servomotor, synchro transmitter receiver.
2. Study using MATLAB of 1st, 2nd order system, laplace transform, inverse laplace transform, PID, various plots such as Root locus, Nyquist plot, Bode Plot.

BEE653 Power Systems II lab

Course Outcomes: At the end of this course students will demonstrate the ability to

1. Analyze the performance of transmission line and relays.
2. Analyze different types of short circuit faults which occurs in power system.

VII SEMESTER

BEE 701 Digital Signal Processing

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	

BEE 702 Advanced Electrical Drives

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	

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CO4	Understand the power electronic converters used for dc motor speed control
CO5	Understand the power electronic converters used for induction motor speed control

BEE 703 Power System Operation and Control

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	

DEEE 704 Energy Audit

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	

OEEE 701 Machine Learning and Python Programming

Course Outcomes: At the end of this course students will demonstrate the ability 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.

BEE 751 Digital Signal Processing Lab

Course Outcomes: After performing the experiments of DSP lab, students will be able to,

1. Understand the use of MATLAB as software tool for the implementation of DSP concepts.
2. Visualize the conceptual similarity between the theory and practical implementation.
3. Understand the concepts of basic signal processing concepts such as convolution, correlation,

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filtering etc.
4. Design the various filters to do various processing on signals.

BEE 752 Internship Assessment
Industrial exposure to students for a period of 30 to 45 days

PROJEE1 Project Stage I

Course Outcomes: At the end of this course students will demonstrate the ability to
Hands on experience in deciding on a project work, collecting literature, finding relevant social / industrial needs and use technological interventions to give appropriate solutions, formulating methodology, working out the solution, analyzing the results and concluding on future prospects

VIII SEMESTER

BEE 801 Industrial Electrical Systems

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	

DEEE 803 Analog and Digital Communication

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	

OEEC 803 Advance Sensors and Transducers

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.

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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.

BHSM 804 Principles of Management

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	

BEE 851 Electrical CAD and Fabrication Lab

Course Outcomes: After completion of this lab, students will be able to,

1. get hands on experience of building some small circuits.
2. get familiar with design process of electronic circuits.
3. understand the use of circuit simulation software required for circuit design.

BEE 852 PROJEE 2 Project Stage II

Course Outcomes: At the end of this course students will demonstrate the ability to **Hands on experience in deciding on a project work, collecting literature, finding relevant social / industrial needs and use technological interventions to give appropriate solutions, formulating methodology, working out the solution, analyzing the results and concluding on future prospects**

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Value Added Course

Course Name	Basic Engineering Drawing
Course Code	DME001
Branch	1st Sem ME/CE and 2nd Sem CSE/ECE/EE
Duration	30 Hrs
Resource Person	Er. Nagendra Singh/Er Ajeet Singh Yadav, Assistant Professor
Organized by	Department of Mechanical Engineering, Institute of Engineering and Technology, Dr. Bhimrao Ambedkar University, Agra

About the Course:

The course teaches you the essential concepts of Drawing instrument box, and gives you an in-depth knowledge of Geometrical construction, curves, point, orthographic projection, First and Third angle Projection, Projection of line, Projection of planes.

Course Objective:

The main objective of this course is to learn the students in latest technologies and also to identify the gap between knowledge of industry and Academics.

Course Content:

Module 1: An Introduction to Engineering Drawing

- Uses of Drawing instrument box
- Sheet layout?
- Free Hand Sketching.
- Different types of Lines?
- Different methods of Lettering?
- Methods of Dimensioning?

Module 2: Orthographic Projection

- Orthographic Projection?
- Methods of Projection.
- Planes of Projection.
- Four Quadrants.
- First angle and Third angle Projection.
- Reference line.

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Module 3: Projection of Points

- Projection of Point
- A point is situated in the first quadrant.
- A point is situated in the second quadrant.
- A point is situated in the third quadrant.

- A point is situated in the fourth quadrant.
- Exercise Problems.

Module 4: Projection of Lines

- Projection of Lines.
- Line Parallel to one or both the planes.
- Line contained by one or both the planes.
- Line Perpendicular to one of the planes.
- Line inclined to one plane and parallel to the other plane.
- Exercise Problems.

Module 5: Projection of the Planes

- Projection of Planes.
- Types of planes.
- Projection of Plane parallel to the H.P. and perpendicular to the V.P.
- Projection of Plane parallel to the V.P. and perpendicular to the H.P.
- Perpendicular to the both reference planes.
- Exercise Problems.

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Basic Engineering Drawing (DME001)

1st Sem ME/CE and 2nd Sem CSE/ECE/EE

Course Outcomes (COs):

CO01:- Understand the basic concepts of drawing instrument box.

CO02:- Develop analyze the orthographic projection.

CO03:- Understand the concepts of projection of points.

CO04:- Practice different problems used for projection of line.

CO05:- Analysis of different method of projection of planes

Program outcomes suggested by the NBA for engineering programs

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2. **Problem analysis:** Identify, formulate, 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 the 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 understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to

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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.

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Value Added Course

Course Name	Elements of Engineering Mechanics
Course Code	DME002
Branch	1st Sem CSE/ECE/EE and 2nd Sem ME/CE
Duration	30 Hrs
Resource Person	Mr. Pushpenda Singh/Er. Vipin Kumar, Assistant Professor
Organized by	Department of Mechanical Engineering, Institute of Engineering and Technology, Dr. Bhimrao Ambedkar University, Agra

About the Course:

The course teaches you the essential concepts of force system, application of kinematics and kinetics of rigid body, to understand the concept of thermodynamics and utilization.

Course Objective:

The main objective of this course is to learn the students to strengthen the concept of force, kinematic and kinetics of rigid body, understand and able to apply the concept of thermodynamics.

Course Content:

Module 1: An Introduction of Force System

- Definition of Force
- Parallelogram Law
- Lami's Theorem
- Principle of Transmissibility of forces
- Resultant of a force system
- Exercise Problems

Module 2: Kinematics of rigid body

- Introduction
- Plane motion of rigid bodies
- Velocity and Acceleration under translation Motion
- Velocity and Acceleration under Rotation Motion
- Relative Velocity
- Projectile Motion

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Module 3: Kinetics of rigid body

- Introduction
- Force, Mass and Acceleration
- Work and Energy
- Impulse and Momentum

- D'Alembert principle and Dynamic equilibrium
- Virtual work

Module 4: Concept of Thermodynamics

- Different application of Engineering Thermodynamics
- Thermodynamic properties, process and cycles
- Thermodynamic equilibrium
- Quasi-static process
- Thermodynamic system
- Thermodynamic process

Module 5: Application of Thermodynamics

- Temperature and its Measurement
- Laws of thermodynamics
- Zeroth Law of Thermodynamics
- First Law of Thermodynamics
- Second Law of Thermodynamics
- Entropy and Properties

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Elements of Engineering Mechanics (DME002)

1st Sem CSE/ECE/EE and 2nd Sem ME/CE

Course Outcomes (COs):

CO01:- Understand the basic concepts force system.

CO02:- Develop analyze the of Kinematics of rigid bodies and different parts.

CO03:- Understand the kinetics of different rigid bodies

CO04:- Remember the fundamental concepts of thermodynamics.

CO05:- Analysis of different method of temperature measurement.

Program outcomes suggested by the NBA for engineering programs

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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.
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Value Added Course

Course Name	Robotics
Course Code	DME003
Branch	3rd Sem CSE/ECE/EE 4th Sem ME/CE
Duration	30 Hrs
Resource Person	Er. Nagendra Singh, Assistant Professor
Organized by	Department of Mechanical Engineering, Institute of Engineering and Technology, Dr. Bhimrao Ambedkar University, Agra

About the Course:

The course teaches you the essential concepts of basics of robotics system, different types of robots, practical application of different types of robots.

Course Objective:

The main objective of this course is to learn the students brief knowledge of industrial applications of robots and performance of kinematics system.

Course Content:

Module 1: An Introduction to Robotics

- Basic concept of Robots?
- History of Robots
- Different terms used in Robots
- Classification of Robots
- Different types of joints are used in robots
- Application of Robots

Module 2: Robot Kinematics

- Understanding of Robot kinematics
- Translation Representation
- Rotation Representation
- Coordinate Transformation
- DH Parameters
- Forward Kinematics

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Module 3: An Introduction to Sensors

- Concepts of Sensors?
- Position, Velocity
- Forces and Moments
- Introduction to Cameras
- Camera Calibration
- Vision applications in robotics

Module 4: Robot Actuation

- Definirotion of robot actuation?
- Types of Actuators
- Electric Actuators
- Hydraulic Actuators
- Pneumatic Actuators
- Gear Transmission

Module 5: An Introduction to Robot Control

- Applications of robot control?
- Basics parameters of control
- Open Loop System
- Close Loop system
- Transfer function
- Robot safety

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Robotics (DME003)

3rd Sem CSE/ECE/EE 4th Sem ME/CE

Course Outcomes (COs):

CO01:- Understand the basics of robotic systems and different types of robots

CO02:- Remember of robot parameters and representation

CO03:- Understand the concept of sensors and application of different sensors

CO04:-Practice the robot actuators and applications of visions

CO05:-Analysis of different process of loops and transfer functions

Program outcomes suggested by the NBA for engineering programs

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Value Added Course

Course Name	3D Printing
Course Code	DME004
Branch	5th Sem ME/CE and 6th Sem CSE/ECE/EE
Duration	30 Hrs
Resource Person	Er. Saurabh Pachauri, Assistant Professor
Organized by	Department of Mechanical Engineering, Institute of Engineering and Technology, Dr. Bhimrao Ambedkar University, Agra

About the Course:

The course teaches you the essential concepts of Concept and fundamentals of 3D printing, and gives you an in-depth knowledgeof types and applications in engineering, medical and design & analysis area, also used of in field bioengineering.

Course Objective:

The main objective of this course is to learn the students brief knowledge of additive manufacturing and different process of 3D printing in the field of engineering and medical.

Course Content:

Module 1: An Introduction to Additive Manufacturing

- Additive manufacturing?
- 3D Printing
- Historical development
- Common use terms
- Types of Additive manufacturing
- Application of Additive manufacturing

Module 2: Introduction to Solid Based Additive Manufacturing

- Solid based additive manufacturing?
- Working principle of solid based additive manufacturing
- Applications of solid based additive manufacturing
- Advantages of solid based additive manufacturing
- Disadvantages of solid based additive manufacturing
- Case studies of solid based additive manufacturing

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Module 3: Introduction to Liquid Based Additive Manufacturing

- Liquid based additive manufacturing?
- Working principle of liquid based additive manufacturing
- Applications of liquid based additive manufacturing
- Advantages of liquid based additive manufacturing

- Disadvantages of liquid based additive manufacturing
- Case studies of liquid based additive manufacturing

Module 4: Introduction to Powder Based Additive Manufacturing

- Powder based additive manufacturing?
- Working principle of powder based additive manufacturing
- Applications of powder based additive manufacturing
- Advantages of powder based additive manufacturing
- Disadvantages of powder based additive manufacturing
- Case studies of powder based additive manufacturing

Module 5: Introduction to 3D Printing

- 3D Printing
- Construction of 3D Printing
- Applications of 3D Printing
- Advantages of 3D Printing
- Disadvantages of 3D Printing
- Case studies of 3D Printing

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3D Printing (DME004)

5th Sem ME/CE and 6th Sem CSE/ECE/EE

Course Outcomes (COs):

CO01:- Understand the basics of concepts of Additive Manufacturing.

CO02:- Remember of robot solid based Additive Manufacturing.

CO03:- Understand the concepts of liquid based Additive Manufacturing.

CO04:- Practice the Powder based Additive Manufacturing.

CO05:- Analysis of different parts of 3D Printing.

Program outcomes suggested by the NBA for engineering programs

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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.

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 centre.

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.

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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.

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.

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.

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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.

Machine Drawing Lab (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.

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.

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.

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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.

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.

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).

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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.

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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.

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.

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.

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Applied Thermodynamics Lab (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.

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4. Demonstrate the performance of internal combustion engine.

5. Understand the working Principles & parts of steam & gas turbine.

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.

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.

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.

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.

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.

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.

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.

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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.

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.

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.

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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.

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.

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.

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.

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.

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.

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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.

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.

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.

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:

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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 gauges.
5. Understanding various aspects of photo elasticity and its application for stress analysis.

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.

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

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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.

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.

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.

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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.

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.

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.

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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.

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.

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.

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.

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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

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.

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.

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.

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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

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.

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.

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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.

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.

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.

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.

Computational Fluid Dynamics (DE-ME-802)

L T P C
3 0 0 3

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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.

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.

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.

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.

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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.

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Department of Computer Science

Institute of Engineering & Technology , Khandari Campus

Dr Bhimrao Ambedkar University, Agra

डा. भीमराव अम्बेडकर वि. वि. आगरा

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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 disciplines
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 computing 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	25
	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	
	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	25
	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	
	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	
	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	25
	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	
	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	25
	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**

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.

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Unit-IV

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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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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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. Hopcroft & 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++ programi 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 Shifier, 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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डा. भीमराव अम्बेडकर वि. वि. आगरा
1927
तमसो मा ज्योतिर्गमय

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 knowledg appropriate for the computing specialization to the abstraction and conceptualization of computing models fron 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.
'O-0	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	25
	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	
	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	25
	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	
	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	
	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	25
	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	
	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	25
	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.

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Unit-IV

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.

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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. Convert a 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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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.

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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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. Hopcroft & 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++ programi 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: Evaluatd 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

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 Shifier, 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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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 Algoritms	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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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).

Programme: Master in Science (Computer Science)	Year: Fourth	Semester: 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.	3
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

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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 class12th and elementary knowledge of any Computer Programming Language.

Suggested equivalent online courses:
http://ugcmoocs.inflibnet.ac.in/ugcmoocs/view_module_pg.php/1484

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-mcqs-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: B070703T	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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Programme/Class: M.Sc. (Computer Science)	Year: Fourth	Semester: VII
Subject: Computer Science		
Course Code: B070901T	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

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	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 Electronic 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, McGrawHill, 2019.
5. C K Shyamala, N Harini, T R Padmanabhan, "Cryptography and Security," Wiley-India, 2011.
6. Godbole, "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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	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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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 Lecture s
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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Programme/Class: B.Sc. (Research) in Science	Year: Fourth	Semester: Eighth
Subject: Computer Science		
Course Code: B070803T	Course Title: Quantum Information & Computation	

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 30 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 this 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.

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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		9
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's-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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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. Quntum 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://learn-xpro.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.

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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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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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Programme/Class: Bachelor(Research) In Science	Year: Fifth	Semester: IX
Subject: **Computer Science**		
Course Code: B070901T	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, liner 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

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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

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Suggested Readings:

1. B. Yegnanarayana"ARTIFICIAL NEURAL NETWORK" PHI Publication, 1998.
2. "Fundamentals of artificial neural networks",MIT press, Mohamed 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.ocw.mit.edu, www.learnartificialneuralnetworks.com, www.neural-forecasting.com

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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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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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VII	**Clustering and Unsupervised Learning** Learning from unclassified data. Clustering. Hierarchical Aglomerative 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 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:

To study this course, a student must have had the subject Mathematics in class12th.

Suggested equivalent online courses:

Further Suggestions:

Programs:

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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. Understand 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 Lectures
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

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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

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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:** 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

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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.	6

Suggested Readings:

1. B.Huges and M.Cotterell- Software Project Management 3rd Edn, TMH, New Delhi, 2004.
2. P.Jalote- 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

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Programme/Class: M.Sc. (Computer science)	Year: Fifth	Semester: Ninth
Subject: Computer Science		
Course Code: B070910T	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 AllPaths.	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

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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. Marc Roper, "Software Testing", McGraw-Hill Book Co., London, 1994.

5. M.C. 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

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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

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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: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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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 recognitiontask. 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

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	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 AlexanderEzhov 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

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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

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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 vendering: View interpolation, Video-based rendering Applications	08

Programme/Class: M.Sc. (Computer science)	Year: Fifth	Semester: Tenth
Subject: Computer Science		
Course Code: B071009T	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

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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.	8
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 Errors, 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. H.Pham. Software Reliability Springer-Verlag, Singapore, 2000.
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.

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)

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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

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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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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

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Programme/Class: M.Sc. (Computer science)	Year: Fifth	Semester: Tenth
Subject: Computer Science		
Course Code: B071018T	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, Serialization, 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, Micheline 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.

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**

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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Department of Computer Science,

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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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Data

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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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 Courses Green color represent Entrepreneurship Course Blue 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.

<u>Course Outcome:-</u>

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 20^{th} 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 .

<u>Course Outcome:-</u>

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 Descriptation: 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

<u>Course Outcome:-</u>

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 Descriptation: 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 Descriptation: 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

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	PSO6
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	PSO6
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**	**PSO6**
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	PSO6
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	PSO
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

Choice based credit system (CBCS)

Department of Botany
School of Life Sciences
Dr. Bhimrao Ambedkar University
Khandari Campus, Agra

Programme: M.Sc. BOTANY

Programme Outcomes (PO's):

Upon completion of the post-graduate program the students will be able to:

PO 1	Develop critical thinking ability and will apply the knowledge to answer scientific queries and expand comprehension potential.
PO 2	Demonstrate graduate attributes like core competency, communication skills, reflective thinking, scientific temper, research skills, digital literacy, moral and ethical awareness.
PO 3	Develop the aptitude for creative thinking, critical analysis and decision making for productive research and development in the area of botanical sciences.
PO 4	Develop effective communication skills through seminar presentations to successfully transfer the scientific knowledge which will facilitate students to look for avenues in higher education.
PO 5	Participate and succeed in various national and international competitive, fellowships and scholarships examinations.

Programme Specific Outcome (PSO's)

Upon completion of M.Sc., Botany degree programme the students will be able to:

PSO 1	Procure updated and quality knowledge in the specialized areas of Botany.
PSO 2	Acquire practical skills in plant diversity and related topics.
PSO 3	Identify plants applying classical and modern taxonomical skills.
PSO 4	Evolve entrepreneurial skills related to advanced fields of Botany.
PSO 5	Equip with various computational skills applied in the field of Bioinformatics.
PSO 6	Gain knowledge in organization of plants at gene, molecular, cellular and tissue level.
PSO 7	Design and carryout biological experiments, projects and interpret data providing meaningful solutions and recommendations.
PSO 8	Beware of environmental issues and live-in harmony with nature.
PSO 9	Utilize bio resources without profiteering motives.
PSO 10	Become competent enough in various analytical and technical skills related to Plant Science.

Core Course	Course Title: M.Sc. Botany I Semester
BOT-C101	Plant Diversity I

Course Objective: The objective of this paper is to provide the knowledge of different groups of Algae, Bryophytes, Pteridophytes and Gymnosperms and their economic importance.

Course Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO10
CO 1	3	2	1	3	-	3	-	3	-	-	-	-	2	3	1
CO 2	3	2	1	3	-	3	-	3	-	-	-	-	2	3	1
CO 3	3	2	1	3	-	3	-	3	-	-	-	-	2	3	1
CO 4	3	2	1	3	-	3	-	3	-	-	-	-	2	3	1

Course Outcomes (COs)

CO 1	Deals with distribution, structure, classification and life history of some groups of algae. Understands with technological application of algae.
CO 2	Classify various Bryophytes and understand their economic uses and deals with distribution, structure, and life history and affinities of bryophytes with other plants.
CO 3	Analyze the morphology, anatomy, reproduction, classification, life, cycle, evolution of stele, heterospory and origin of seed habit of different groups of Pteridophytes and evolution of Pteridophytic orders understand the concept of Fossil Pteridophytes.
CO 4	Understand classification, general characters, distribution and phylogeny, economic importance of Gymnosperms. Critically differentiate the character of four orders of Gymnosperms i.e. Cycadales, Coniferales, Ginkoales and Gnetales.

M.Sc. Botany I semester

Core Course

BOT-C101 Plant Diversity- I

UNIT I

Phycology: Algae in diversified habitats; thallus-organization; cell ultrastructure; reproduction (vegetative, asexual and sexual); classification of algae; pigments, reserve food, flagella; algal blooms, Economic importance of algae(as fertilizers, food feed and industry).

Classification, salient features of Chlorophyta, Xanthophyta, Bacillariphyta, Phaeophyta and Rhodophyta.

UNIT II

Bryophytes: Morphology, structure, reproduction and life history; distribution; Sporophyte evolution of bryophytes; classification; general account of Marchanitales, Jungermaniales, Anthocerotales, Funariales, economic and ecological importance.

UNIT III

Pteridophyta: Morphology, anatomy and reproduction; classification, life cycle, evolution of stele; heterospory and origin of seed habit.

General account of fossil pteridophyte, Brief introduction of Psilopsida, Lycopsida, Sphenopsida and Pteropsida

UNIT IV

GYMNOSPERMS

Classification of Gymnosperms. Comparative study vegetative, anatomical and reproductive structures of Cycadophyta, Coniferophyta and Gnetophyta. Evolutionary trends and phylogenetic relationship among various groups of Gymnosperms. Economic importance of Gymnosperms.

Syllabus covers Value addition, Employability, Skill development and Entrepreneurship

Core Course	Course Title: M.Sc. Botany I Semester
BOT-C102	Plant Diversity II

Course Objective: This paper deals with diversity of microbes: classification, distribution, characters and structure of viruses, bacteria, fungi and phytoplasma and to provide the knowledge of plant pathology and diseases caused by different plant pathogens.

Course Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO10
CO 1	3	1	2	3	-	3	-	3	-	-	3	-	3	2	1
CO 2	3	1	2	3	-	3	-	3	-	-	3	-	3	2	1
CO 3	3	1	2	3	-	3	-	3	-	-	3	-	3	2	1
CO 4	3	1	2	3	-	3	-	3	-	-	3	-	3	2	1

Course Outcomes (COs)

CO 1	Understand the general account, Ultrastructure, Nutrition and Reproduction and economic importance of Archaebacteria and Eubacteria and Cyanobacteria
CO 2	Rememberingthe Characteristics, Ultrastructure of Viruses and Virions. Their isolation and purification techniques. Their chemical nature,replication, transmission and Economic importance. General characters of Phytoplasma and their role in causing diseases.
CO 3	Apply the position of Fungi in latest classification system. List the morphological and anatomical characters of groups and examples of groups. Exemplify endosymbiotic and symbiotic associations of lower groups. Implement bioprospecting of Fungi.Remembering the brief information of plant diseases, symptoms and economic importance and deals with causal organism, symptoms and control of some plant diseases along with general principles of plant disease management. Deals with methods of isolation of pathogens and their culture.
CO 4	Understanding the idea of fungal cell structure, nutrition and reproduction. Provides the knowledge of plant parasitic fungi and their economic importance.

M.Sc. Botany I semester

Core Course

BOT-C102 Plant Diversity- II

UNIT I

Archaebacteria and eubacteria: General account; ultrastructure, nutrition and reproduction biology and economic importance: cyanobasseri-salint feature and biological importance.

UNIT II

Viruses: Characteristics and ultrastructure of virions; isolation and purification of viruses; chemical nature, replication, transmission viruses; economic importance.

Phytoplasma: General characteristics and role in causing plant diseases.

UNIT III

Mycology and Plant Pathology:

Fungi: General characters of fungi: substrate relationship in fungi; cell ultrastructure, unicellular and multicellular organization;

Plant Pathology: Concept of disease in plants; Definition of plant disease; Historical development of Plant Pathology. Methods of studying plant diseases: Collection, preservation, isolation of pathogens and proving Koch postulates. Symptoms caused by Plant Pathogenic fungi, bacteria and viruses. Brief Classification of Plant diseases.

UNIT IV

General account of Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina, Deuteromycotina; fungi in industry, medicine anc as food; fungal diseases in plant humans; Mycorrhizae, fungi as biocontrol agents.

Cell wall composition; nutrition-saprobic, biotrophic, symbiotic; reproduction-vegetative, asexual and sexual; heterothallism; heterokaryosis; Para sexuality; recent trends in classification, phylogeny of fungi.

Syllabus covers Value addition, Employability, Skill development and Entrepreneurship.

Core Course	Course Title: M.Sc. Botany I Semester
BOT-C103	Plant Physiology and Metabolism

Course Objective: The main purpose of this paper is to provide the knowledge of different aspects of physiology and metabolism of nitrogen and lipid etc.

Course Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO10
CO 1	3	3	3	3	-	3	-	-	2	3	3	-	2	-	3
CO 2	3	3	3	3	-	3	-	-	2	3	3	-	2	-	3
CO 3	3	2	3	3	-	3	-	-	2	3	3	-	2	2	3
CO 4	3	1	3	3	-	3	-	-	2	3	3	-	2	2	3

Course Outcomes (COs)

CO 1	Understand the concepts of thermodynamics and photobiology. This unit covers the information of Enzymology, plant water relation and mineral nutrition. Provides the knowledge of Signal Transduction, Phospholipid Signaling and Sucrose sensing mechanism in bacteria and plants.
CO 2	Deals with photosynthesis and respiration steps. This unit applies and analyzes the metabolism of lipid.
CO 3	This unit helps in remembering the metabolism of nitrogen and sulphur.
CO 4	Provides the understanding of growth regulators and sensory photobiology.

M.Sc. Botany I semester

Core Course

BOT-C103 PANT PHYSIOLOGY AND METABOLISM

UNIT I

Energy flow: Principles of thermodynamics, free energy and chemical potential redox reaction structure and function of ATP.

Fundamentals of enzymology: General account, isozymes, kinetics of enzymatic catalysis, Michel's Menten equation and its significance.

Membrane transport and translocation of water and solutes: Plant water relations, mechanism of water transport through xylem, phloem; passive and active solute transport, membrane transport problems.

Signal transduction: Overview, receptors and G-proteins, phospholipid signaling, role of cyclic nucleotides, calcium-O clamodulin cascade, diversity in protein kinases and phosphatases, specific signaling mechanism, e.g. two component sensor regulating system in bacteria and plants, sucrose sensing mechanism.

UNIT II

Phytochemistry and photosynthesis: Evolution of photosynthetic apparatus, photosynthetic pigment and light harvesting complexes, photooxidation of water, mechanism of electron and proton transport, carbon assimilation-the Calvin cycle, photorespiration, C4 cycle, CAM pathway.

Respiration and Lipid metabolism: Glycolysis, TCA cycle, electron transport and ATP synthesis, pentose phosphate pathway, glyoxylate cycle, alternative oxidases system structure and function of lipids, fatty acid biosynthesis and their catabolism.

UNIT III

Nitrogen fixation, Nitrogen and Sulphur metabolism: Overview, biological nitrogen fixation, nodule formation and nod factors, mechanism of nitrate uptake and reduction, ammonia assimilation

Sensory photobiology: Phytochromes and their photochemical and biochemical properties, photoperiodism and its significance, vernalization

UNIT IV

Plant growth regulators and elicitors: Physiological effect and mechanism of action of auxin, gibberellins, cytokinin, ethylene, abscisic acid, brassinosteroids and polyamines

Syllabus covers Value addition, Employability, Skill development and Entrepreneurship

Core Course	Course Title: M.Sc. Botany I Semester
BOT-C104	Plant Morphology and Anatomy

Course Objective: The chief objective of this paper is to understand about the development of root, shoot and leaf as well as secretary ducts.

Course Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO10
CO 1	3	-	2	3	-	3	-	2	3	-	1	-	2	-	3
CO 2	3	-	2	3	-	3	-	2	3	-	1	-	2	-	3
CO 3	3	-	2	3	-	3	-	2	2	-	1	-	2	-	3
CO 4	3	-	2	3	-	3	-	2	2	-	1	-	2	-	3

Course Outcomes (COs)

CO 1	Provides the knowledge of understanding of Unique features of Plant Development.
CO 2	Provides the knowledge of understanding of Seed Germination and Seedling Growth.
CO 3	This unit helps in the remembering of Shoot System in Flowering plants.
CO 4	This unit helps in the remembering of Root System in Flowering plants.

M.Sc. Botany I semester

Core Course

BOT-C104 PLANT MORPHOLOGY AND ANATOMY

UNIT I

Introduction: Unique features of plant development. Differentiates specialization and morphogenesis.

UNIT II

Seed Germination and seedling growth: Metabolism of nucleic acids, proteins and mobilization of food reserves; tropisms hormonal control of seedling growth; gene expression

UNIT III

Shoot development: Organization of the shoot apical meristem (SAM); Cytological and molecular analysis of SAM; control of cell division and cell to cell communication; anomalous secondary growth; tissue differentiation- xylem and phloem; secretary ducts and laticifers; wood development in relation to environmental factors; nodal anatomy.

UNIT IV

Leaf growth and differentiation: Determination; phyllotaxy; control of leaf form; differentiation of epidermis (with special reference to stomata and trichomes and mesophyll.

Root Development: Organization of root apical meristem (RAM); cell fates and lineages; vascular tissue differentiation; lateral roots, root hairs; root-microbe interactions, Rood nodules.

Syllabus covers Value addition, Employability, Skill development and Entrepreneurship.

Core Course	Course Title: M.Sc. Botany I Semester
BOT-C105	Practicals

Course Objective: Exercises corresponding to the theory courses.

Course Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO10
CO 1	3	3	3	3	-	3	3	3	1	-	2	1	3	2	3
CO 2	3	3	3	3	-	3	3	3	1	-	2	1	3	2	3
CO 3	3	3	3	3	-	3	3	3	1	3	3	3	3	2	3
CO 4	3	3	3	3	-	3	3	3	1	-	2	3	3	2	3

Course Outcomes (COs)

CO 1	To give the students some detail idea for the evaluation of Cryptogams (Algae, Bryophytes, Pteridophytes and Gymnosperms) classification. Preparation and study of temporary and permanent slides of vegetative and reproductive structures of various genera of Cryptogams (Algae, Bryophytes, Pteridophytes and Gymnosperms). To create the plant specimens under various genera according to the syllabus in the field study (local) by specimen collection, preservation and study in the field of Cryptogams (Algae, Bryophytes, Pteridophytes and Gymnosperms)
CO 2	To give the students some detail idea for the evaluation of fungal and bacterial classification, vegetative and reproductive structures of fungi. Preparation and study of temporary and permanent slides of fungi and bacteria. To create the various plant specimens under various genera according to the syllabus in the field study (local) by specimen collection, preservation and study in the field Pathogens (Viruses, Bacteria and Fungi). Understanding introduction to plant pathology, classification of diseases, process of infection and pathogenesis.
CO 3	Evaluate the basic physiological relationship of Plant, water and soil and translocation of organic solutes Mechanism of stomatal transpiration, Photosynthesis and Respiration. Analyze the basic biochemical and physiological knowledge about the utility and estimation of different plant contents (Chlorophyll content, Proline, Carbohydrates). To get detail practical knowledge about Separation and identification of sugars and amino acids by paper chromatography. To learn how to determine water potential of plant tissue. To learn how to determine Chlorophyll- a, Chlorophyll- b and total Chlorophyll and carotenoid.
CO 4	To give the students some detail idea about Angiosperms (Dicots as well as Monocots). Create the temporary and permanent slides by the section cutting of roots and stems of Angiosperms (Dicots as well as Monocots) with double staining.

Core Course	Course Title: M.Sc. Botany II Semester
BOT-C201	Angiosperms, Systematic and Economic Botany

Objective: The main objective of this paper is to understand the concept of species, variation, speciation, genus, family and classification of angiospermic plants and their Economic importance.

Course Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO10
CO 1	3	2	2	3	-	3	-	2	2	-	1	-	3	3	3
CO 2	3	2	2	3	-	3	-	1	2	-	1	-	3	3	3
CO 3	3	2	3	3	-	3	-	3	3	-	1	-	3	3	3
CO 4	3	2	3	3	-	3	-	3	3	-	1	-	3	3	3

Course Outcomes (COs)

CO 1	Provides the knowledge to understand the Plant Diversity and concept of Species.
CO 2	This unit deals with the applicable knowledge of Taxonomic Tools.
CO 3	This unit helps in remembering of the Classification in Angiosperms.
CO 4	Provides the knowledge to understand the description of the families of Angiosperms (Dicotyledons and Monocotyledons).

M.Sc. Botany II semester

Core Course

BOT-C201 ANGISOPERMS, SYSTEMATICS AND ECONOMIC BOTANY

UNIT I

Origin of in trapopulation variation and the environment: ecades and ecotype: Ex. hotspots plant diversity.

The species concept: Taxonomic hierarchy, species, genus, family and other categories; Modern trends in plant taxonomy: Anatomy in relation to taxonomy, embryology in relation to taxonomy; salient features of the ICBN

UNIT II

Taxonomic tools: Herbarium, numerical taxonomy, cytotaxonomy, chemotaxonomy, serological and molecular taxonomy

UNIT III

Systems of angiospermic classification: Phenetic verses phylogenetic system: Bentham& Hooker, Engler and Prantell& Hutchinson's system; relative merits and demerits of major systems

UNIT IV

Description of the families:

(a) **Dicotyledons:** Ranunculaceae, Rutaceae, Meliaceae, Euphorbiaceae, Malvaceae, Apiaceae, Apocynaceae, Asciemadacoae, Cnvolvuiaceae, Lamiaceae, Solanaceae, Rubiaceae, Cucurbitaceae, Asteraceae, Verbinaceae

(b) **Monocotyledons:** Poaceae, Cyperaceae, Palmae, Zingiberaceae, Orchidaceae

Syllabus covers Value addition, Employability, Skill development and Entrepreneurship

Core Course	Course Title: M.Sc. Botany II Semester
BOT-C202	Plant resources utilization and Conservation

Course Objective: This paper deals with plant resources and their utilization as well as conservation.

Course Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO10
CO 1	3	3	3	3	-	3	3	1	2	3	3	3	3	3	3
CO 2	3	3	3	3	-	3	2	1	3	2	3	3	3	3	3
CO 3	3	3	3	3	-	3	3	1	3	2	3	3	3	3	3
CO 4	3	3	3	3	-	3	3	1	3	3	3	3	3	3	3

Course Outcomes (COs)

CO 1	Deals with understand to different procedures of plant conservation. Provides information of some revolutions occurred for conservation of plants.
CO 2	Provides the information to remember the some domesticated plants used as cereal, fiber and medicine.
CO 3	Provides the information to remember some oil yielding, fire and timber plants.
CO 4	Provides the information of understand the Green Revolution and its consequences. Plants used as avenue trees for shades, pollution control and aesthetics and general account and activities of different governmental institutions which are engaging conservation and research activities (BSI, NBPGR, ICAR, CSIR, DBT).

M.Sc. Botany II semester

Core Course

BOT-C202 PLANT RESOURCES UTILIZATION AND CONSERVATION

UNIT I

Strategies for conservation- *In situ* conservation: International efforts and Indian initiatives; protected areas in India-Sanctuaries, National Parks, biosphere reserves, wetlands, mangroves and coral reefs for conservation of wild biodiversity.

Strategies for conservation: ex situ conservation: Principles and practices; botanical gardens, field gene banks, *in vitro* repositories, cryobanks.

UNIT II

Origin, evolution, botany, cultivation and uses of food, forage and fodder, fiber, medicinal and aromatic plants, and vegetable oil yielding crops.

UNIT III

Important fire wood and timber yielding plants and non-wood forest products (NWFPs) such as bamboos, rattans, raw materials for paper making, tannins, dyes, resins and fruits.

UNIT IV

Green revolution: Benefits and adverse consequences.

Innovations for meeting world food demand.

Plants used as avenue trees for shade, pollution control and aesthetics.

Principles of conservation; extinction's environmental status of plant based on International union for conservation of Nature.

General account of the activities of Botanical Survey of India (BSI); National Bureau of Plant Genetic Resources (NBPGR), Indian Council of Agricultural Research (ICAR), Council of Scientific & Industrial Research (CSIR), and the Department of Biotechnology (DBT) for conservation, non-formal conservation efforts.

Syllabus covers Value addition, Employability, Skill development and Entrepreneurship.

Core Course	Course Title: M.Sc. Botany II Semester
BOT-C203	Fundamentals of Ecology

Course Objective: The main objective of this syllabus is to provide the knowledge of ecosystem, biodiversity and ecological management.

Course Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO10
CO 1	3	2	3	3	-	3	2	3	2	1	1	3	3	3	3
CO 2	3	2	3	3	-	3	2	3	2	1	1	3	3	3	3
CO 3	3	2	3	3	-	3	2	3	2	1	1	3	3	3	3
CO 4	3	2	3	3	-	3	2	3	2	3	-	3	3	3	3

Course Outcomes (COs)

CO 1	Provides the knowledge to evaluate the Climate, soil and vegetation patterns of Life zones and Vegetation Organization.
CO 2	Apply the knowledge to understand the Vegetation patterns.
CO 3	Analyze the knowledge of Ecosystem and its Organization.
CO 4	Evaluate the Air, Water and Soil Pollution. Provides the knowledge of Climate change.

M.Sc. Botany II semester

Core Course

BOT-C203 FUNDAMENTALS OF ECOLOGY

UNIT I

Climate, soil and vegetation patterns of Life zones: major biomer and major vegetation. Soil types, pedogenesis; physical and chemical characters.

Vegetation Organization: Concepts of community and continuum; analysis of communities (analytical and synthetic characters); inter-and intra-specific associations; concept of ecological niche.

UNIT II

Vegetation development: Temporal changes (Cyclic and non-cyclic); mechanism of ecological succession; Ecological life-cycle of plants; autoecology, genecology- gene study in India, synecology.

UNIT III

Ecosystem Organization: Structure and functions; primary production (methods of measurement), energy dynamics (trophic organization, energy flow pathways, ecological efficiencies; global biogeochemical cycles of C, N, P and S.

Biological Diversity: Concepts of levels; role of diversity in ecosystem functions and stability; speciation and extinction; IUCN categories of threat; distribution and global warming, sea level rise, UV radiation.

UNIT IV

Air, water and soil pollution: Kinds; source; quality parameters; effects on plants and ecosystems.

Climate change: Greenhouse gases (CO_2, CH_4, N_2O, CFCs: source, trends and role); ozone layer and ozone hole; consequences of climate change (CO_2 fertilization, global warming, sea level rise, UV radiation).

Syllabus covers Value addition, Employability, Skill development and Entrepreneurship.

Core Course	Course Title: M.Sc. Botany II Semester
BOT-C204	**Plant Cell, Tissue and Organ Culture**

Course Objective: The main objective of this paper is to understand the tissue culture and genetic engineering techniques.

Course Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO10
CO 1	3	3	3	3	-	3	3	2	3	1	3	3	3	3	3
CO 2	3	3	3	3	-	3	3	2	3	1	3	3	3	3	3
CO 3	3	3	3	3	-	3	3	2	3	1	3	3	3	3	3
CO 4	3	3	3	3	-	3	3	2	3	3	3	3	3	3	3

Course Outcomes (COs)

CO 1	Understand the different tissue culturing procedures for culturing different parts of plant.
CO 2	Provides the information to understand the Meristem and Embryo Culture.
CO 3	Remember the different tools and procedures of tissue culture. Knowledge of protoplast isolation and somatic hybridization.
CO 4	Remember the methods of preservation and storage of germplasm.

M.Sc. Botany II semester

Core Course

BOT-C204 PLANT CELL, TISSUE AND ORGAN CULTURE

UNIT I

General introduction, history scope, concept of cellular differentiation and totipotency; Tissue culture media; preparation and sterilization procedures; Anther culture production of androgenic hapoids, bullbosum method.

UNIT II

Meristem culture and production of disease-free plants; Cell culture and production of secondary metabolites / natural products; Embryo culture.

UNIT III

Callus culture, somatic embryogenesis and production of synthetic seeds; Endosperm culture; Somatic hybridization: Protoplast isolation fusion and culture, hybrid selection and regeneration possibilities.

UNIT IV

Somaclonal and gametoclonal variation; Clonal propagation; Cryopreservation, germplasm storage and gene banks. Germplasm conservation and synthetic seed technology, Industrial application. Suspension culture, hairy root culture and bioreactors

Syllabus covers Value addition, Employability, Skill development and Entrepreneurship.

Core Course	Course Title: M.Sc. Botany II Semester
BOT-C205	Practicals

Course Objective: Exercises corresponding to the theory courses.

Course Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO10
CO 1	3	3	3	3	-	3	3	3	3	1	3	3	3	3	3
CO 2	3	3	3	3	-	3	3	3	3	2	3	3	3	3	3
CO 3	3	3	3	3	-	3	3	3	3	2	3	3	3	3	3
CO 4	3	3	3	3	-	3	3	3	3	3	3	3	3	3	3

Course Outcomes (COs)

CO 1	To give the students some detail idea to understand the Description of the families of Angiosperms and How to prepare Herbarium.
CO 2	To give students practical understandings of various plant resources and its utilization.
CO 3	To give the students some detail idea to understand the soil profile and soil properties. To give students practical understandings of species abundance, density and frequency.
CO 4	To give students practical understandings of different types of tissue culture medias and micropropagation of various explants.

Core Course	Course Title: M.Sc. Botany III Semester
BOT-C301	Biology of Plant Reproduction

Course Objective: The main of objective of this paper is to understand the embryology of monocots and dicots.

Course Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO10
CO 1	3	2	2	3	-	3	2	1	-	-	1	-	2	1	3
CO 2	3	3	2	3	-	3	2	1	-	-	2	-	2	1	3
CO 3	3	2	2	3	-	3	2	1	-	-	1	-	1	1	3
CO 4	3	3	2	3	-	3	2	1	-	-	2	-	2	2	3

Course Outcomes (COs)

CO 1	Provides the knowledge for remembering the Methods of reproduction in flowering plants and Pollination.
CO 2	Provides the knowledge to analyze Pollen-Pistil interaction and Pollen Physiology.
CO 3	Provides the knowledge for remembering of Morphology of Carpels.
CO 4	Evaluate the development of Seed biology.

M.Sc. Botany III semester

Core Course

BOT-C301 BIOLOGY OF PLANT REPORDUCTION

UNIT I

Methods of reproduction in flowering plants: Vegetative, asexual, sexual and parasexual mode reproduction. Sexual system in flowering plants. Structure and development of male gametophyte and female gametophyte.

Pollination: Self and cross pollination, flower structure in relationship to the mono of pollination, contrivances promoting cross pollination, methods of cross pollination, insect pollination, the pollinators and causal factors, attractants and reward of pollination.

UNIT II

Pollen-Pistil interaction: Significance of pollen pistil interaction, structure of stigma and style, post- pollination events, fertilization.

Pollen Physiology: Viability, FCR, Alexander's stain, TLC

UNIT III

Carpel Morphology: Form of carpel, closure of carpel, complex carpel, solid carpel, placentation.

UNIT IV

Seed Biology: Seed and fruit physiology of growth and development, interaction of seed and Twit, involvement of extraovarian parts in fruit development. Physiology of seed germination, seed dormancy and seedling establishment. **Morphological sterility:** Mechanical and physiological factors. **Incompatibility:** Sexual incompatibility, general concepts, mechanism of intraspecific incompatibility Methods employed for overcoming incompatibility.

Syllabus covers Value addition, Employability, Skill development and Entrepreneurship

Core Course	Course Title: M.Sc. Botany III Semester
BOT-C302	Mycology and Plant Pathology

Course Objective: The objective of this paper is to provide the knowledge of different types of pathogens and biochemical effects on them.

Course Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO10
CO 1	3	3	1	3	-	3	3	2	1	1	1	-	3	3	3
CO 2	3	3	3	3	-	3	2	3	1	2	2	-	3	3	3
CO 3	3	3	1	3	-	3	2	2	1	1	1	-	3	3	3
CO 4	3	3	2	3	-	3	3	2	1	1	1	-	3	3	3

Course Outcomes (COs)

CO 1	Deals with understands to introduction, general characteristics, ecology and distribution of different orders of Fungi.
CO 2	Provides the knowledge of Applied Mycology and Role of fungi in Biotechnology.
CO 3	This unit helps in remembering the introduction of the Plant Pathology.
CO 4	Provides the knowledge to evaluate the Geographical distribution of Diseases.

M.Sc. Botany III semester

Core Course

BOT-C302 MYCOLOGY AND PLANT PATHOLOGY

Unit I

Introduction. General characteristics; Ecology and Distribution; Thallus organization; EM of haustorium and septum: Wall composition: Nutrition; Growth; Reproduction and spore); Heterokaryosis and Para sexuality; Sexual compatibility: Life cycle patterns of Myxomycota. Oomycota, Zygomycota, Ascomycota, Basidiomycota, Deuteromycota.

Unit II

Applied Mycology Role of fungi in biotechnology Application of fungi in food industry of flavour& texture. Fermentation. Baking, Organic acids, Enzymes, Mycoproteins); Secondary metabolites Pharmaceutical preparations); Agriculture (Biofertilizers): Mycotoxins; Biological Control (Mycofungicides, Mycoherbicides, Mycoinsecticides, Myconematicides); Medical mycology.

Unit III

Plant Pathology Introduction: Definition: Importance; Terms and Concepts, Classification; Causes, Symptoms Host Pathogen relationships

Unit IV

Geographical distribution of diseases; etiology, symptomology, disease cycle and environmental relation; prevention and control of plant diseases, and role of quarantine

Syllabus covers Value addition, Employability, Skill development and Entrepreneurship.

Core Course	Course Title: M.Sc. Botany III Semester
BOT-C303	Molecular Biology and Genetic Engineering

Course Objective: The main objective of this paper is to understand about the cell organelles and techniques used in cell biology and to provide the knowledge of DNA, genes and chromosomes as well as their different functions and activities.

Course Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO10
CO 1	3	3	3	3	-	3	-	1	3	3	3	3	3	3	3
CO 2	3	3	3	3	-	3	-	1	3	3	3	3	3	3	3
CO 3	3	3	3	3	-	3	-	1	3	3	3	3	3	3	3
CO 4	3	3	3	3	-	3	-	1	3	3	3	3	3	3	3

Course Outcomes (COs)

CO 1	Apply the Basic concepts, principles and scope of Molecular Biology and Genetic Engineering.
CO 2	Provide the Knowledge to understand the Genetic Engineering of Plants.
CO 3	Analyze the Microbial manipulations.
CO 4	Provides the knowledge to understand the Genomics and Proteomics.

M.Sc. Botany III semester

Core Course

BOT-C303 MOLECULAR BIOLOGY AND GENETIC ENGINEERING

UNIT I

Basic concepts, principle and scope of molecular biology and genetic engineering.

Recombinant DNA technology: Gene cloning principles and techniques, construction of genomic/c DNA libraries, choice of vectors, DNA synthesis and sequencing, polymerase chain rejection, DNA fingerprinting.

UNIT II

Genetic Engineering of plants: Aims, strategies for development of transgenics (with suitable examples), Agrobacterium- the natural genetic engineer, T-DNA and transposon mediated gene tagging, chloroplast transformation and its utility, intellectual property rights.

UNIT III

Microbial Genetic Manipulation: Bacterial transformation, selection of recombinants and transformants, genetic improvement of industrial microbes and nitrogen fixers, fermentation technology.

UNIT IV

Genomics and Proteomics: Genetic and physical mapping of genes, molecular markers for introgression of useful traits, artificial chromosome, high throughout sequencing, genome projects, bioinformatics, microarrays.

Syllabus covers Value addition, Employability, Skill development and Entrepreneurship.

Core Course	Course Title: M.Sc. Botany III Semester
BOT-E304	**Cytogenetics**

Course Objective: The main objective of this paper is to provide the knowledge of DNA, genes and chromosomes as well as their different functions and activities.

Course Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO10
CO 1	3	3	3	3	-	3	2	1	3	3	3	2	3	3	3
CO 2	3	3	3	3	-	3	2	1	3	3	3	2	3	3	3
CO 3	3	3	3	3	-	3	3	1	3	3	3	2	3	3	3
CO 4	3	3	3	3	-	3	2	1	3	3	3	2	3	3	3

Course Outcomes (COs)

CO 1	Analyze the Organization of Chromatin.
CO 2	Provides the knowledge to understand theStructural and Numerical alterations in Chromosomes.
CO 3	Deals with the study to remember the Genetics of Prokaryotes and Eukaryotic Organelles.
CO 4	Provides the knowledge to analyze the different types of Mutations.

M.Sc. Botany III semester

Elective

BOT-E304 CYTOGENETICS

UNIT I

Chromatin Organization: Chromosome structure and packaging of DNA, molecular organization of centromere and telomere; nucleolus and ribosomal RNA genes; euchromatin and heterochromatin; chromosomes-polythene, Lampbrush, B-chromosome and sex chromosome, molecular basis of chromosome pairing.

UNIT II

Structural and numerical alterations in chromosomes: Origin, meiosis and breeding behavior of duplication, deficiency, inversion and translocation heterozygotes; origin, occurrence, production and meiosis of haploids, aneuploids and euploids; origin and production of autopolyploid; chromosomes and chromatid segregation; allopolyploids, types, genome constitution and analysis; evolution of wheat and paddy crop induction and characterization of trisomics and monosomic.

UNIT III

Genetics of Prokaryotes and eukaryotic organelles: Mapping the bacteriophage genome; phage phenotypes; genetics recombination phage; genetics transformation, conjugation and transduction in bacteria; cytoplasmic male sterility.

Gene Structure and Expression: Genetics fine structure; cis-trans test; fine structure analysis of eukaryotes; introns and their significance; regulation of gene expression in prokaryotes and eukaryotes.

UNIT IV

Mutations: Spontaneous induced mutations; physical and chemical mutagens; molecular basis of gene mutations; transposable elements in prokaryotes and eukaryotes; mutations induced by transposons; site- directed mutagenesis; DNA damage and repair mechanisms.

Syllabus covers Value addition, Employability, Skill development and Entrepreneurship.

Core Course	Course Title: M.Sc. Botany III Semester
BOT-E305	Plant Breeding

Course Objective: The objective of this paper is to impart the basic knowledge of Cytogenetics and plant breeding in detail.

Course Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO10
CO 1	3	3	3	3	-	3	2	3	3	1	3	2	3	3	3
CO 2	3	3	3	3	-	3	2	3	3	3	3	2	3	3	3
CO 3	3	3	3	3	-	3	2	3	3	2	3	2	3	3	3
CO 4	3	3	3	3	-	3	2	3	3	3	3	2	3	3	3

Course Outcomes (COs)

CO 1	Deals with the study to understand the Cytogenetics of Anuploids and Structure of Heterozygotes.
CO 2	Provides the knowledge to analyze theAllien gene transfer and Chromosome manipulation.
CO 3	Applying of Perspectives of Plant Breeding. Methods of Reproduction in Crop Plants and Breeding methods in Crops.
CO 4	Apply the knowledge of Polyploidy. Mutation and Biotechnology in Crop improvement and Seed production practices.

M.Sc. Botany III semester

Elective

BOT-E305 Plant Breeding

UNIT I

Cytogenetics of anuploids and structure heterozygote: Effect of an on phen.... transmission of monosomics and trisomics; breeding behavior and genetics of structure heterozygotes; translocation tester sets; Robertsonian translocation; B-B translocation.

UNIT II

Alien gene transfer, chromosome manipulation: transfer of whole genome, example from wheat, Arachis and Brassica; transfer of individual chromosomes and chromosome segments; method of detecting alien chromatin; production characterization and utility of alien addition and substitution lines; genetic basis of inbreeding and heterosis; exploitation of hybrid vigor.

UNIT III

Perspectives of plant breeding, methods of reproduction in crop plants and breeding methods in crops:

a. Aims and achievements of plant breeding

b. Breeding methods for self-pollinated crops, pure line breeding and mass selection, pedigree method

c. Selection in cross pollinated crops, Recurrent selection, Clonal selection

d. Hybrid and synthetic varieties

e. Heterosis and in breeding depression

UNIT IV

Polyploidy mutation and biotechnology in crop improvement. seed production practices:

a. Autoploidy, Allopolyploidy and aneuploidy, seed production practices

b. Mutation breeding: procedure, achievements and pitfalls of mutation breeding

c. Haploid production Embryo culture, somatic cell hybridization, genetic engineering

d. Seed production practices: Improved varieties, role of seed certification, National seed corporation, seed labeling and seed testing

Syllabus covers Value addition, Employability, Skill development and Entrepreneurship.

Core Course	Course Title: M.Sc. Botany III Semester
BOT-C306	Practicals

Course Objective: Exercises corresponding to the theory courses.

Course Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO10
CO 1	3	3	3	-	-	3	3	3	3	1	2	3	3	3	3
CO 2	3	3	3	-	-	3	3	3	3	1	2	3	3	3	3
CO 3	3	3	3	-	-	3	3	3	3	3	3	3	3	3	3
CO 4	3	3	3	-	-	3	3	3	3	1	2	3	3	3	3
CO 5	3	3	3	-	-	3	3	3	3	2	2	3	3	3	3

Course Outcomes (COs)

CO 1	To give the students some detail practical idea to create morphology of Flowers belonging to different families of Angiosperms. To give students practical understandings of seed viability and pollen-pistil interactions.
CO 2	To give students practical understandings of Plant diseases caused by Bacteria, Fungi and Viruses.
CO 3	To give the students some detail practical idea for the evaluation ofapplications of Genetic Engineering in the development of plants.
CO 4	To give the students some detail practical idea to apply the knowledge in cell organelles, types of cell division and mutations.
CO 5	To give the students some detail practical idea to remember the breeding methods in Crop plants.

Core Course	Course Title: M.Sc. Botany IV Semester
BOT-C401	**Biostatistics and Computer Applications**

Course Objective: The main objective of this paper is to understand in brief about biostatistics and Computer Applications.

Course Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO10
CO 1	3	3	3	3	-	3	-	-	3	3	-	3	-	3	3
CO 2	3	3	3	3	-	3	-	-	3	3	-	3	-	3	3
CO 3	3	3	3	3	-	3	-	-	3	3	-	3	-	3	3
CO 4	3	3	3	3	-	3	-	-	3	3	-	3	-	3	3

Course Outcomes (COs)

CO 1	Apply the knowledge of concepts of Biostatistics and Biometry.
CO 2	Evaluate the study of Deviations, Variances and Elementary Probability.
CO 3	Apply the knowledge of Simple linear regression and correlation.
CO 4	Evaluation of Computer organization, Programming Techniques, Software's and its applications.

M.Sc. Botany IV semester

Core Course

BOT-C401 Biostatistics and Computer Application

UNIT I

1. Concepts of statistics and biometry
2. Continuous and discontinuous variables
3. Brief description and tabulation of data in its graphical representation.

UNIT II

1. Measures of central tendency and dispersion, mean, median mode, range, standard deviation, variance
2. Elementary probability: addition and multiplication laws.

UNIT III

1. Simple linear regression and correlation
2. Idea of two types of errors and level of significances, test of significance (F & t test); chi-square tests.

UNIT IV

1. Introduction of digital computers: organization; low level and high level language; binary number system.
2. Flow charts and programming techniques.
3. Introduction to programming techniques.
4. Introduction to programming techniques.
5. Introduction to data structure and database concepts, introduction to internet and its application.
6. Introduction to MS-Office software, covering Word Processing, Spreadsheets and Presentation software- introduction to Corel Draw.

Syllabus covers Value addition, Employability, Skill development and Entrepreneurship.

Core Course	Course Title: M.Sc. Botany IV Semester
BOT-C402	Cell Biology and Plant Biochemistry

Course Objective: The main objective of this paper is to understand about the cell organelles and techniques used in cell biology and plantbiochemistry.

Course Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO10
CO 1	3	3	3	3	-	3	-	2	3	2	3	3	3	3	3
CO 2	3	3	3	3	-	3	-	2	3	3	3	3	3	3	3
CO 3	3	3	3	3	-	3	-	2	3	3	3	3	3	3	3
CO 4	3	3	3	3	-	3	-	2	3	3	3	3	3	3	3

Course Outcomes (COs)

CO 1	Apply the knowledge of Cell components in detail.
CO 2	Analyze the knowledge of Classification, Structure, Function and Metabolism of Carbohydrates, Proteins and Lipids.
CO 3	Apply the detail Knowledge of Plant Growth Hormones.
CO 4	Apply the General aspects, Characteristics and Classification of Enzymes.

M.Sc. Botany IV semester

Core Course

BOT-C402 CELL BIOLOGY AND PLANT BIOCHEMISTRY

Unit-I

Cell components:

Structural and functional aspects of cytoskeleton system, role in cell organization and movement, organization of microtubules, microfilaments and plasmodesmata. Ultrastucture and function of microbodies, Golgi apparatus, lysosomes, peroxisomes, endoplasmic reticulum, vacuole, ribosomes, nucleus and nucleolus. Structural organization and functions of: Cell wall and Plasma membrane. Membrane transport: Structure and functions of ion carriers, channel proteins.

Unit-II

Classification, structure and functions of: Carbohydrates- Monosaccharides, oligosaccharides, polysaccharides (storage and structural) Amino acids- protein, non- protein, essential and non-essential. Proteins- simple and conjugated Lipids- Fatty acids, simple and compound lipids. Nitrogen and sulfur metabolism: Biological nitrogen fixation, nitrogenase enzyme complex, nodule formation and nod factors. Mechanism of nitrate reduction-nitrate and nitrite reductase. Ammonia assimilation. Assimilation of sulfur.

Unit-III

Plant growth hormones:

Biosynthesis, function and mechanisms of action of Auxins. Gibberellins. Cytokinins. Abscisic acid, Ethylene. Brasssinosteroids, Polyamines, Jasmonic acid and Salicyclic acid.

Unit-IV

Enzymes:

General aspects, characteristics and classification. Factors affecting enzyme activity Active sites and mode of action. Regulation of enzyme activity and allosteric mechanism Enzyme inhibition - reversible and irreversible, competitive and non-competitive. Enzyme kinetics and Michaelis-Menton equation.

Syllabus covers Value addition, Employability, Skill development and Entrepreneurship.

Core Course	Course Title: M.Sc. Botany IV Semester
BOT-E403	In Vitro Plant Propagation

Course Objective: The main objective of this paper is to impart the basic knowledge of tissue culture, germplasm storage, growth regulators and mutagenesis.

Course Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO10
CO 1	3	3	3	3	-	3	2	3	3	3	3	3	3	3	3
CO 2	3	3	3	3	-	3	2	3	3	3	3	3	3	3	3
CO 3	3	3	3	3	-	3	2	3	3	3	3	3	3	3	3
CO 4	3	3	3	3	-	3	2	3	3	3	3	3	3	3	3

Course Outcomes (COs)

CO 1	Analyze the basic concepts, Principles and Scope of Plant Cell and tissue culture.
CO 2	Provides the knowledge to understand the Organogenesis and Embryogenesis.
CO 3	Deals with the detail knowledge to apply Micropropagation.
CO 4	Deals with the knowledge of Applications of Plant Tissue culture.

M.Sc. Botany IV semester

Elective

BOT-E403 In Vitro Plant Propagation

Unit I

Basic concepts, principles and scope of Plant cell and tissue culture: General introduction, history, concept of cellular differentiation, totipotency.

Unit II

Organogenesis and adventives embryogenesis: Fundamental aspects of morphogenesis somatic embryogenesis and androgenesis. Mechanism techniques and utility. Somatic hybridization: Protoplast isolation, fusion and culture, hybrid selection and regeneration. Possibilities, achievements and limitation of protoplast research.

Unit III

Micropropagation- Factors affecting morphogenesis and proliferation rate; technical problems in micropropagation. Organogenesis- formation of shoots and roots, production of virus free plants by meristem and shoot-tip culture

Unit-IV

Application of plant tissue culture: Clonal propagation, artificial seed, production of hybrids and somaclones. Production of secondary metabolites/ natural products. Cryopreservation and germplasm storage.

Syllabus covers Value addition, Employability, Skill development and Entrepreneurship.

Core Course	Course Title: M.Sc. Botany IV Semester
BOT-E404	Stress Physiology of Plants

Course Objective: The main objective of this paper is to impart the knowledge of secondary metabolites, regulatory metabolism and physiological stresses on plants.

Course Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO10
CO 1	3	3	3	3	-	3	-	1	3	-	3	3	3	3	3
CO 2	3	3	3	3	-	3	-	1	3	-	3	3	3	3	3
CO 3	3	3	3	3	-	3	-	1	3	-	3	3	3	3	3
CO 4	3	3	3	3	-	3	-	1	3	-	3	3	3	3	3

Course Outcomes (COs)

CO 1	Apply the knowledge of Biological Stress and Physical stress.
CO 2	Analyze with the knowledge of Low Temperature Stress.
CO 3	Evaluate the knowledge of Nutrient Deficiency Stress.
CO 4	Apply the knowledge of Water deficit.

M.Sc. Botany IV semester

Elective

BOT-E404 Stress Physiology of Plants

Unit-I

Biological stress vs. Physical Stress, Types of stresses and general methods of measurement of stress response (Strain), Stress physiology in crop improvement, Response to UV stress: Injury and resistance mechanism

Unit- II

Response to low temperature stress: Chilling, freezing, frost injury and mechanism of resistance, Adaptations, Response to high temperature stress: Injury and mechanism of resistance, Heat shock proteins, Adaptations

Unit –III

Response to nutrient deficiency stress, Heavy metal stress, injury and mechanism of resistance, adaptations, Salinity stress, Ionic and salt stress injury, mechanism of resistance

Unit-IV

Response to water deficit: Desiccation, Dehydration injury; Mechanism of resistance, Adaptations, Response to water excess: Flooding, hypoxia, Mechanism of resistance, Adaptations, Causative agents for Biotic Stresses, Mechanism of Resistance against Fungal, Bacterial and viral pathogens

Syllabus covers Value addition, Employability, Skill development and Entrepreneurship

Core Course	Course Title: M.Sc. Botany IV Semester
BOT-E405	**Environmental Biotechnology**

Course Objective: The chief objective of this syllabus is to impart the knowledge of different types of pollution and their sources and effects on plants and the environmental effects on plants and pathogens as well as their control.

Course Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO10
CO 1	3	3	3	3	-	3	1	-	3	1	1	3	3	3	3
CO 2	3	3	3	3	-	3	1	-	3	3	1	3	3	3	3
CO 3	3	3	3	3	-	3	3	-	3	1	2	3	3	3	3
CO 4	3	3	3	3	-	3	1	-	3	1	2	3	3	3	3

Course Outcomes (COs)

CO 1	Apply the knowledge of Pollution and Pollutants.
CO 2	Analyze the knowledge of Climate Change.
CO 3	Deals with the knowledge to understand the Ecosystems Stability.
CO 4	Evaluate the Ecological Management and Phytoremediation.

M.Sc. Botany IV semester

Elective

BOT- E405 ENVIRONMENTAL BIOTECHNOLOGY

Unit – I

1. Pollution and Pollutants: Cost of pollution, Kinds of Pollution and Pollutants- Air, Water, and Soil Pollution, Their effects on Plants and Ecosystems;
2. Role of Plants in Pollution Management.

Unit – II

3.Climate Change: Greenhouse Gases (CO2, CH4, N2O, CFCs: sources and roles), Ozone layer and Ozone hole, Consequences of Climate change (acid rain, global warming, sea level rise, UV radiation).

Unit – III

Ecosystem Stability: Concept (resistance and resilience), Ecological Perturbations (natural and anthropogenic) and Their Impacts on Plants and Ecosystems, Ecology of Plant Invasion, Environmental Impact Assessment (EIA), Ecosystem Restoration.
Environment and energy, Energy resources – Renewable and Non-renewable. Natural resources, Loss of Diversity, causes and consequences, Environmental Auditing, Conservation of Biodiversity.

Unit – IV

Ecological Management: Concepts, Sustainable Development, Remote sensing and GIS as Tools for Resources Management.
Phytoremediation: Prevention and Control, Methods of reducing Environmental impacts of Chemicals, Weedicides, Pesticides and Fertilizers. Biotechnological advances in pollution control through GEMs.

Syllabus covers Value addition, Employability, Skill development and Entrepreneurship.

Core Course	Course Title: M.Sc. Botany IV Semester
BOT-E406	**Ethnobiology and Ethnopharmacology**

Course Objective: The chief objective of this paper is to impart the knowledge of Ethnobiology and Ethnopharmacology.

Course Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO10
CO 1	3	3	3	3	-	3	3	2	2	-	1	3	3	3	3
CO 2	3	3	3	3	-	3	3	2	2	-	1	3	3	3	3
CO 3	3	3	3	3	-	3	3	2	3	-	1	3	3	3	3
CO 4	3	3	3	3	-	3	3	2	2	-	2	3	3	3	3

Course Outcomes (COs)

CO 1	Apply the brief knowledge of Ethnobotany.
CO 2	Evaluate the brief knowledge of Ethnobiology.
CO 3	Understand the brief knowledge of Ethnopharmacology.
CO 4	Analyze the brief knowledge of Natural products from Plants.

M.Sc. Botany IV semester

Elective

BOT- E406 ETHNOBIOLOGY AND ETHNOPHARMACOLOGY

UNIT- I ETHNOBOTANY

Ethnobotany: concept, history, evolution and scope; Indigenous knowledge and traditional practices of some Himalayan communities; Taxonomic epidermal characters and pharmacognostical studies to check adulteration. Problems and prospects of value addition applicable to plant resources. Scope for development of plant resources.

UNIT II: ETHNOBIOLOGY

Major ethnic group in North East India, their social institutions, livelihood, cultural and religious practices Shamanism and other belief systems, sacred groove and methods of biological resource conservation. Current status of Ethnobiology; Ethnobiology, biodiversity and traditional knowledge;

UNIT- III ETHNOPHARMACOLOGY

Role of Ethnobotany in drug discovery. Ayurvedic drug preparation and drug adulteration. Chemical composition of few medicinal and aromatic plants, extraction and uses pertaining to typical Indian formulation of drugs. Ethnopharmacological validation of traditional medicine; approaches to drug discovery from ethnobotanical leads.

UNIT- IV NATURAL PRODUCTS FROM PLANTS

Definition, importance and systematics and characterization of Natural products. Phenolic acids, alkaloids, glycosides, terpenoids, flavonoids, steroids, tannins in plants kingdom. Function of secondary metabolite for plant defense and protection.

Syllabus covers Value addition, Employability, Skill development and Entrepreneurship.

Core Course	Course Title: M.Sc. Botany IV Semester
BOT-C407	Practicals

Course Objectives: Exercises corresponding to the theory courses.

Course Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO10
CO 1	3	3	3	3	-	3	1	1	3	3	-	3	3	3	3
CO 2	3	3	3	3	-	3	1	2	3	3	2	3	3	3	3
CO 3	3	3	3	3	-	3	2	3	3	3	3	3	3	3	3
CO 4	3	3	3	3	-	3	1	3	3	3	2	3	3	3	3
CO 5	3	3	3	3	-	3	2	3	3	3	1	3	3	3	3
CO 6	3	3	3	3	-	3	2	3	3	3	2	3	3	3	3

Course Outcomes (COs)

CO 1	To give students practical understandings to create Computer and its Software's and Biostatistical analysis of Data.
CO 2	To give students practical understandings evaluate the Cell organelles and Role of Plant Growth regulators (Auxin, Cytokinin, Gibberellin, Ethylene, Abscisic Acid), and Enzymes and Metabolism of Carbohydrates, Proteins and Lipids.
CO 3	To give the students some detail practical idea to understand the Micropropagation.
CO 4	To give the students some detail practical idea to remember Biotic and Abiotic Stresses.
CO 5	To give the students some detail practical idea to analyze Pollutants and Components of Ecosystem and Bioremediation.
CO 6	To give students practical understandings of Uses of Medicinal Plants.

Core Course	Course Title: M.Sc. Botany IV Semester
BOT-C408	Industrial Training/Survey/Research Project

Course Objective: To develop the research temperament in this field.

Course Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO10
CO 1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO 2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO 3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO 4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

Course Outcomes (COs)

CO 1	Projects for students in 5 identifies fields Plant Genetics, Plant Physiology, Angiosperm Taxonomy, Plant ecology and Plant Biotechnology are carried on under the supervision of subject expert in different identified fields.
CO 2	Project work deals with literature review, understanding local issues and challenges and generating solution for the same.
CO 3	Students capacity as a researcher and preparing them for further research work is being supervised identifying his or her own area of interest.
CO 4	This also helps the students to explore a subject in depth, manage a research project and define a suitable question and to use the appropriate research tools. Seminars, study tours, collection of specimens, cultivating crops (on specialized area) regular filed visit, data collection, survey, laboratory analysis, data interpretation, learning research methodology, joining in workshops, presenting papers in seminars, application of Biostatistics and bioinformatics on their data, writing skills, visiting advance laboratories and industries etc are some of the tools applicable while doing the projects.

List of students undertaken for field and research project in the academic year 2021-22.

S.NO.	NAME	TITLE
1.	Bharti Baghel	Effect of lead (Pb) induced change on some biochemical parameters on *Vigna radiate* L. (Mung)
2.	Chanchal Sharma	Effect of chromium (Cr) a heavy metal and some growth parameters of *Vigna radiate* L. (Mung bean)
3.	Gireesh Chand	Qualitative screening of some secondary phytochemicals in *Cuscuta reflexa* Roxb.
4.	Neha Aziz	Quantification of primary phytochemicals *Cuscuta reflexa* Roxb. as parasite on *Ziziphus mauritiana* as host
5.	Pragyanjali	Estimation of some primary phytochemicals of *Cuscuta reflexa* Roxb. on the host *Ricinus communis* L.
6.	Priya Verma	Assesment of Arsenic as heavy metal on the biochemical parameters of Mungo L.
7.	Pretty Sharma	Qualitative analysis of phytochemicals present in the leaves of *Aloe vera* L.
8.	Prahalad Yadav	A review on therapeutic potential of *Prosopis cineraria*
9.	Sangeeta Yadav	Anti-diabetic activity of flavonoid and phenolic compound in the leaves of *Hibiscus rosa-sinensis* L.
10.	Sanjay Yadav	Effect of various concentration GA_3 on germination and seed vigour of different varieties of Sorghum (*Sorghum bicolor*)
11.	Satakshi Upadhyay	Screening of some secondary metabolites in *Ricinus communis* and *Cuscuta reflexa*
12.	Surabhi Singh	Qualitative screening of some secondary phytochemicals in *Ziziphus mauritiana* and *Cuscuta reflexa*
13.	Varshita Baghel	Screening of some secondary phytochemicals in the leaves of *Syzygium cumuni* L.

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 study plants 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 enrich 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 tospecific 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** 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	**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; Commercial products 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, Biopolymers, 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. L. 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 I. 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, Prentice 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://gcfambathach.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-PP%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)**
I.	**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* Rhodophyceae - *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-I** 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://nlib.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/7926d7789d8a2f7b2075109f08e3175e.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=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/

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-Verlag, 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://mhsorchid.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://paleobotany.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 scientist to 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. Sumra, 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. Sumra, 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-e9236e.pdf
https://img.kiar.gov.in/library/rrg/rrg.pdf
https://agritech.tnau.ac.in/banking/nabard_pdf/Azolla%20Cultivation/Model_project_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) Quanitities 0P0!2.010H1TYLIP - 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, shrubsand 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 India. 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.[illegible]/school-improvement/get-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. Electron 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. Berjauski, 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%20II%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=336680&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 natural 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 specimen 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
3. Day, S.C. (2003)Complete Home Gardening, (2003) Agrobios, Jodhpur, India.
2. Dhagne, 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. Kumaresan 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.nicce.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 McGraw-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 Contemporary 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

Five 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, CIMAP 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 Dongarkar. 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 book 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- Pharmacognosy- 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 Sreeramu, B. S. 2001. Cultivation 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. 1990. Organic chemistry of natural products. 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. Aseline, 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 Rhizome 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.legalservicesindia.com/article/198-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://nopr.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.html

<table>
<tr><td>Programme: Diploma</td><td>Year: II</td><td>Semester: IV Paper-II</td></tr>
<tr><td colspan="3">Subject: Botany</td></tr>
<tr><td>Course Code: BOTB402P</td><td colspan="2">Course Title: Commercial Botany & Phytochemical Analysis</td></tr>
<tr><td colspan="3">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</td></tr>
<tr><td>Credits: 2</td><td colspan="2">Core Compulsory</td></tr>
<tr><td>Max. Marks CIE: 25
Max. Marks End Semester Examination:75
Total Max. Marks: 100</td><td colspan="2">Min. Passing Marks CIE:09
Min. Passing Marks End Semester Examination: 26
Total Min. Passing Marks: 35</td></tr>
<tr><td colspan="3">Total No. of Lectures-Tutorials-Practical (in hours per week): 0-0-2</td></tr>
</table>

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. Raychaudhuri, 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 Test/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.cmrgreencarindia.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
http://www.hentoti.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; Ramachandran 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. & Hüner, 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.), 1999?, Wadsworth 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. Buchanan, Gruissem 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-days-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
III	**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. F.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.classcu.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 HCO3 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 — Klinostat 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 experimentsthrough photographs 2. Numericals based on DNA reassociation 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** 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	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)- aneuploidy and Euploidy-haploidy, polyploidy- significance (Structural aberrations) - deletion, duplication, inversion and translocation.	8
II	**Genetics** Chromosomic 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 techiniques 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 Razdan An Introduction to Plant Tissue Culture –, Oxford & 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, Harol 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.ascl.com/ASCT/WebContent/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, V.K. Concept of Ecology, Latest Ed., S. Chand & Company
6. Odum, E.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. Kumar, 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. & Yeong, A.K.W. Concepts and Techniques of Geographic Information Systems, 2002, Prentice-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 Tchobanoglous, 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: 1 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 Mendelian 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 3. Phytogeographical areas of India	7
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 & Golam 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.

INSTITUTE OF HOME SCIENCE,

Khandari, Agra

Running and proposed Courses

Total Courses in the Institute of Home Science:

- Number of Employability courses – 13
- Number of Value added courses – Nil
- Number of skill development courses – 03
- Number of entrepreneurship courses–05

Name of the Courses	Course Outcomes	Value Added Course/ Employability Course/ Skill Development Course/ Entrepreneurship Course
Courses running from Session: July 2022		
B.Sc. (H.Sc.)	• To understand the role of home science in the development of individual, families and communities. • To learn about the sciences and technologies which enhance the quality of life of the people.	Employability Course

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	• To acquire professional and entrepreneurial skills for economic empowerment of students in particular and community in general. • To develop and benefit from the symbiotic relationship among the core disciplines of Home Science- Food and nutrition, Textile and Apparel Design, Human development & family studies, extension communication and management, Family resource management. • To take science from the laboratory to the people.	
M.Sc. (H.Sc.) General	• To develop the capabilities and knowledge of students in the area of – ✓ Human development and family studies ✓ Food and nutrition ✓ Extension communication and management ✓ Textile and Apparel Design ✓ Family resource management • To develop skills and make the students efficient in academics, industry and community service in the field of home science.	Employability Course
M.Sc. (H.Sc.) Specialization in Human Development and Family Studies	• To describe the growth and development of human from conception to late adulthood, as well as to understand family issues and developmental challenges that occur due to biological and ecological conditions. • To understand physiological changes in pregnancy and lactation and competent for health care of the elderly. • To understand the inter-relationship between heredity and environment during life cycle.	Employability Course

	• To create awareness regarding current trends, issues and research in Human Development and Family Studies. • To describe the distinctive growth and development of individuals from conception to late adulthood, as well as to understand family issues and developmental challenges that occur due to biological and ecological conditions. • To gain the skills to establish Entrepreneurial setups like Early childhood educational centre, Centre for Special Children, Home for aged, Home for Orphans and destitute, Short stay homes for women in difficult circumstances • To develop effective skills to extend guidance and counseling services to needy people, to identify the developmental challenges through scientific measures and to provide a stimulating environment and intervention for needy people for their optimum development. • To facilitate the students to work professionally and efficiently in academics, research, curriculum development, management of institutions and welfare programs, training, extension and community services relate to human development.	
M.Sc. (H.Sc.) Specialization in Food and Nutrition	• To acquire knowledge in food science, nutrition and dietetics. • To assess the nutritional status of individuals in various life cycle stages and determine nutrition related problems and disease by applying knowledge of metabolism and nutrient functions, food sources	Employability Course

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	and physiological systems in community, hospitals and in any situation. • To understand the concepts of food microbiology and food safety. • To develop the food products applying the principles of food science and nutrition to meet the challenges of nutritional problems. • To conduct the research in different fields of nutrition. • To apply appropriate techniques to develop, process, preserve the different components of food products. • To communicate effectively nutrition information from individual to community. • To acquire skills in writing research report, documentation, case studies, seminars, presentation, group discussions. • To be able to recommend and provide appropriate nutritional care for prevention / and treatment of the various diseases. • To provide practical field level experience in Institutional food administration. • To demonstrate the national and international food laws and regulations and safety standards in application of food additives to ensure safe foods. • To facilitate the students to work professionally and efficiently in academics, research, teaching, diet counselor, food industry, welfare programs, training, extension and community services relate to nutrition.	

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M.Sc. (H.Sc.) Specialization in Extension Communication and Management	• To provide foundation in extension communication and management. • To develop knowledge about recent trends in extension education at regional, national and global levels. • To develop understanding on community development, panchyat raj and rural welfare. • To provide deep understanding about policies and programmes for women, children and youth • To understand the concept of Extension Methods and Materials • To develop understanding regarding the types of communication methods, materials, functions, aids and teaching-learning process. • To provide skills in participatory rural appraisal techniques and understanding of transfer of technology • To develop understanding regarding the role of various mass media in Extension Communication and management. • To conduct fields studies and different projects of local and regional needs. • To develop understanding regarding cyber communication, media and Journalism. • To facilitate the students to work professionally and efficiently in academics, research, teaching, institutions and welfare programs, training, extension and community.	Employability Course

M.A. (H.Sc.)	• M.A Home Science has been innovatively designed to enable students to acquire knowledge in the field of - ✓ Human development and family studies ✓ Food and nutrition ✓ Extension communication and management ✓ Textile and Apparel Design ✓ Family resource management • The curriculum has an integrated approach of combining theory, practical and field work. • To develop relevant skills and make students efficient in academics, research, industry and community service in the field of Home Science	Employability Course
PG Diploma in Nutrition and Dietetics	• To become proficient for specialization in nutrition. • To provide an understanding of composition of various food stuffs. • To know the effect of the various diseases on nutritional status. • To be able to recommend and provide appropriate nutritional care for prevention and treatment of the various diseases. • To understand the nutritional requirements and recommendations through the life cycle. • To facilitate the students to work professionally and efficiently in academics, researches, health care sector, food industries, welfare programs.	Employability Course, Entrepreneurship Course

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Certificate Course in Food Processing and Preservation	• To understand the scientific principles and techniques of food processing and preservation. • To acquire skills to establish food service outlet. • To formulate nutritious food products. • To develop analytical skills to be employed in industries. • To develop skill to analyze food quality. • To gain employment in central and state government sectors. • To competent to take up careers in academics, researches, health care, Processing and preservation industries.	Employability Course, Entrepreneurship Course Skill development
Ph.D. in Home Science	• The course focuses on: ✓ Research, ✓ Innovation ✓ Capacity building. • Make the students self-reliant with necessary proficiencies for a wide variety of career with entrepreneurial skills. • Practical training/exposure through internship, field visit, project work, expert lectures, demonstration, workshops and seminars gives hands-on experience to students. • Students are sensitized towards challenges and solutions for societal development from grass-root level. • Continuous innovations evolved through scientific researches in post graduate programs empower women and family with solutions to deal with everyday challenges.	Employability Course

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Courses proposed from Session: July 2023		
B.A. (H.Sc.)	• B.A Home Science has been innovatively designed to enable students to acquire knowledge in the field of – ✓ Human development and family studies ✓ Food and nutrition ✓ Extension communication and management ✓ Textile and Apparel Design ✓ Family resource management • To understand the role of home science in the development of individual, families and communities. • To learn about the sciences and technologies which enhance the quality of life of the people. • To acquire professional and entrepreneurial skills for economic empowerment of students in particular and community in general.	Employability Course

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Certificate Course in NGO Management	• The NGO Management course is specifically designed mainly to empower the students with the managerial skills and knowledge required to start a career as a social worker. • It teaches students about social work which includes working for the betterment of underprivileged people. This vast sector deals with various social issues ranging from health care, and education to community development. • The course provides the participants with the necessary knowledge and skills to work in a diverse and challenging work environment along with training for a career in social work which also includes work in NGOs and helping government organizations by conducting studies and surveys.	Employability Course Entrepreneurship Course
Diploma in Textile Design	• The course makes one eligible for a career in textiles designing. Candidate can apply for various jobs in various industries such as interior furnishings, fashion industry, merchandisers, dyeing and printing works, etc. • It also empowers one with skill to one's own start up with little investment. • An entrepreneur not only is financially independent but has satisfaction of providing employment to others as well. • Many govt. schemes provide loans for even small entrepreneurs for their start – ups.	Employability Course, Skill Development Course, Entrepreneurship Course

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Diploma in Apparel Design	• The course makes one eligible for a career with leading apparel manufactures, but both at domestic and export levels. • It also empowers one with the skill to start one's own start up (boutique or manufacturing unit) with little investment. • An entrepreneur not only is financially independent but has satisfaction of providing employment to others as well. • Many govt. schemes provide loans for even small entrepreneurs for their start- ups.	Employability Course, Skill Development Course, Entrepreneurship Course

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DEPARTMENT OF CHEMISTRY (w.e.f. 2022-23 session onwards)

Course Offered based on NEP-2020 (CBCS system)

Year	Course	Semester/ Course paper No.	Course Title	Marks		Total	Credits	Total Credits
				Internal	External			
4-year	M.Sc. Chemistry (or Bachelor in Research if left in IV[th] year)	VII-SEM						
		C-1	COMPUTER FOR CHEMISTS	25	75	100	5	24
		C-2	INORGANIC CHEMISTRY	25	75	100	5	
		C-3	ORGANIC CHEMISTRY	25	75	100	5	
		C-4	PHYSICAL CHEMISTRY	25	75	100	5	
		C-5	MINOR (ADULTRANT IN FOODS)	25	75	100	4	
		VIII-SEM						
		C-6	GROUP THEORY AND SPECTROSCOPY	25	75	100	4	28
		C-7	BIO- INORGANIC CHEMISTRY	25	75	100	4	
		C-8	BIO-PHYSICAL CHEMISTRY	25	75	100	4	
		C-9	SPECTROSCOPIC METHODS OF ANALYSIS	25	75	100	4	
		C-10	PRACTICAL			100	4	
		C-11	RESEARCH PROJECT			100	8	
5-year	M.Sc. Chemistry	IX-SEM						
		C-12	PHOTO AND STEREOCHEMISTRY	25	75	100	5	20
		C-13	SOLID STATE CHEMISTRY, SURFACE PHENOMENON AND CHEMICAL EQUILIBRIA	25	75	100	5	
		C-14	COORDINATION CHEMISTRY	25	75	100	5	
		C-15	*ELECTIVE-1 (BASIC ANALYTICAL CHEMISTRY)	25	75	100	5	
		C-16	*ELECTIVE-2 (CHEMISTRY OF NATURAL PRODUCTS)	25	75	100	5	
		X-SEM						
		C-17	INTERDISCIPINARY TOPICS	25	75	100	4	
		C-18	SEPERATION TECHNIQUES	25	75	100	4	28
		C-19	**ELECTIVE-1 (ADVANCE ANALYTICAL METHODS)	25	75	100	4	
		C-20	**ELECTIVE-2 (ADVANCE INORGANIC CHEMISTRY)	25	75	100	4	
		C-21	**ELECTIVE-3 (ADVANCE ORGANIC CHEMISTRY)	25	75	100	4	
		C-22	**ELECTIVE-4 (ADVANCE PHYSICAL CHEMISTRY)	25	75	100	4	
		C-23	**ELECTIVE-5 (POLYMER CHEMISTRY)	25	75	100	4	
		C-24	**ELECTIVE-6 (INDUSTRIAL CHEMISTRY)	25	75	100	4	
		C-25	**ELECTIVE-7 (MEDICINAL CHEMISTRY)	25	75	100	4	
		C-26	PRACTICAL			100	4	
		C-27	RESEARCH PROJECT			100	8	

*ELECTIVE PAPERS C-15, C-16 choose any ONE and in **ELECTIVE PAPERS C-19, C-20, C-21, C-22 Choose any ONE and from C-23, C-24 and C-25 choose any ONE paper.

Purpose of the Program

The purpose of the M.Sc. Program at the University is to provide the key knowledge of various disciplines in Chemistry and on Advances in this field. To prepare students for careers as professional in various Research Institutes and Industries.

Programme Outcomes

Ensures the students to understand, acquire knowledge in Quantum Chemistry, Group Theory Symmetry, Photochemistry, Advanced Concepts in Spectroscopy, Polymer Science, Green Chemistry, Solid State, Natural Products, disconnection approach as well as role of Modern Synthetic Reagents in Organic Transformations, Nanotechnology, Thermodynamics, Advanced Chemical Kinetics, Surface Analytical Techniques to measure Surface Properties of materials and the Advanced Principles of various Electrochemical Techniques and all branches of Chemistry. This syllabus also ensures the students to understand acquire knowledge and have hands on experience in multistep Inorganic/ Organic Compound Synthesis and Analysis by using Spectroscopic Techniques and have hands on experience in multistep Organic Synthesis and Analysis by using Spectroscopic Techniques.

PROGRAME SPECIFIC OUTCOME (PSO)

PSO 1- Students will understand the basic concepts, fundamental principles and the scientific theories related to various scientific phenomena and their relevancies in the day to day life. They will also be able to acquire knowledge about the fundamentals and applications of chemical and scientific theories.

PSO 2- Students will find that every branch of science and technology is related to science subjects but also in all aspects related to life.

PSO 3-Student will become familiar with different branches of chemistry like analytical, organic, inorganic, physical, environmental, polymer, medicinal. They will also learn to apply appropriate techniques for the qualitative and quantitative analysis of chemicals in the laboratories in industries.

PSO 4- The student will acquire knowledge of chemical thermodynamics, kinetics, electrochemistry, organic, inorganic, bio-organic, bio-inorganic, spectroscopy and skill in industrial chemistry.

PSO 5- Viewing chemistry as a tool developing mind and critical attitude and thinking of logical reasoning that is prepared to serve in diverse fields.

PSO 6- Student will gain a thorough knowledge in the subject to be able to work in projects at different research as well as academic institution.

C-1 **COMPUTERS FOR CHEMISTS** **CREDITS-05**

After completion of this course successfully the students will be able to

CO1- acquire knowledge about the history and development of computer.

CO2-aquint will the different softwares and the operating systems used in computer.

CO3- provide basic knowledge about the internet, networking.

CO4- aware about the tool used in chemistry.

CO5- acquire knowledge about the use of MS office, multimedia tool for presentation in chemistry.

C-2 **INORGANIC CHEMISTRY** **CREDITS-05**

After completion of this course successfully the students will be able to

CO1-understand the principle of various bonding theories and identify the structure and bonding of metal cluster and complex molecules.

CO2- have a firm foundation in the fundamental techniques and scientific theories in nuclear chemistry.

CO3- understand the bonding and structure in metal clusters and also the spatial arrangements of molecules with different oxidation state of metals.

CO4- learn the synthesis applications of macrocycles in biological system.

CO5- appreciate the existence and application of inorganic compounds.

C-3 **ORGANIC CHEMISTRY** **CREDITS-05**

After completion of this course successfully the students will be able to

CO1- acquaint with the basic ideas of chemical bonding, stability in molecules and obtain theoretical understanding of how reactive intermediates.

CO2- obtain theoretical understanding of how inorganic reaction take place in substitution reactions.

CO3- obtain theoretical understanding of stereochemistry of inorganic molecules of elimination reactions.

CO4- understand the reactions and mechanistic pathways of organic reactions.

CO5- explore about the reagents commonly used in organic synthesis.

C-4 **PHYSICAL CHEMISTRY** **CREDITS-05**

After completion of this course successfully the students will be able to

CO1-get basic idea about fundamental of quantum chemistry.

CO2- get exposure about the statistical thermodynamics.

CO3- study the kinetics of different types of reactions and methodologies.

CO4- impart knowledge of micelles and macromolecules.

CO5- get the fundamentals and theories of electrochemistry.

C-5 **ADULTERANTS (MINOR for other Faculty)** **CREDITS-05**

After completion of this course successfully the students will be able to

CO1- get information about the different types of food and adulteration based on local and national needs.

CO2- to study the detection of adulterants.

CO3- analyze the adulterant in local materials commonly available in house hold products for employability.

CO4- impart knowledge about the false labelling and fake products in food packets available nationally and internationally.

CO5- get awareness about the food safety and standard and different standard laid down by the government.

C-6 **GROUP THEORY AND SPECTROSCOPY** **CREDITS-05**

After completion of this course successfully the students will be able to

CO1- understanding the basic concepts of molecular symmetry and to analyze the point group of chemical molecules.

CO2- apply the applications of rotational and vibrational spectroscopy.

CO3- On learning the course, students will be able to apply the concepts of electrostatic transitions in molecules.

CO4- familiarize the importance of AAS in metal analysis.

CO5- perform low cost, analysis of metals using flame photometry for local need.

C-7 **BIO-INORGANIC CHEMISTRY** **CREDITS-05**

After completion of this course successfully the students will-be able to

CO1- learn the transport mechanism of metal ions in biological systems.

CO2- familiarize with structure and functions of biomolecules.

CO3-impart knowledge of bio-inorganic pigments.

CO4- learn the concepts of biochemistry of metals as well as nitrogen fixation.

CO5- to study the fundamentals of toxicity of metals and also to learn the metals ions as chelating agent in medicine.

C-8 **BIO-PHYSICAL CHEMISTRY** **CREDITS-05**

After completion of this course successfully the students will be able to

CO1- to understand the structure and theories of enzymes.

CO2- appreciate the importance and function of coenzymes.

CO3- study of the free energy in biochemical reactions.

CO4- learn the functions of transport of ion in cell membrane.

CO5- understand the different physical parameters in biological systems.

C-9 **SPECTROSCOPIC METHODS OF ANALYSIS** **CREDITS-05**

After completion of this course successfully the students will be able to

CO1- understand the theories of absorption spectroscopy.

CO2- know the fundamentals of raman spectroscopy.

CO3- learn the fundamentals and applications of NMR spectroscopy.

CO4- understand the fragmentation takes in mass spectrometry.

CO5- know the fundamentals of electronic spin resonance spectroscopy.

C-10 M.Sc. CHEMISTRY PRACTICAL (Semester VIII) **CREDITS-04**

After completion of this course successfully the students will,be able to

CO1-analyze common chemical from their identity and composition

CO2- estimate different ions, and organic compounds quantitative and qualitatively.

CO3- gather experience on synthesis of inorganic materials and organic compounds.

CO4- analyze structure of organic compounds by use of spectra

CO5- have hand on experience / practical knowledge in performing physical experiments.

C-11 **RESEARCH PROJECT** **CREDITS-08**

After completion of this course successfully the students will be able to

CO1- understand research problems.

CO2- execute literature search on a research topic.

CO3- design new experiments to address research problems.

CO4- conducts experiments in a scientific way.

CO5-analyze and interpretation of the results.

C-12 PHOTO AND STEREOCHEMISTRY **CREDITS-05**

After completion of this course successfully the students will be able to

CO1- acquaint with the general principles involved in photochemistry.

CO2- understand the organic reactions involved in photochemistry and able to differentiate between photochemical and thermal reaction.

CO3- provide concept of chirality, various method for projection of chiral molecules, and effect of rotation on energy level.

CO4- learn the chiroptical properties and will able to analyze how a chiral compound is optical active.

CO5- get knowledge of separation of stereo organic compounds i.e., resolution of racemates and also how the organic compounds show selectivity based on functional group.

C-13 **SOLID STATE CHEMISTRTY, SURFACE PHENOMENONAND CHEMICAL EQUILIBRIA** **CREDITS-05**

After completion of this course successfully the students will be able to

CO1- understand the basic knowledge of crystal structure.

CO2- provide understanding of crystal defects in solid state and the properties associated in solid.

CO3- impart knowledge of electronic properties of metal, insulators and semiconductors.

CO4- learn the concept of physical and spectral properties of the surface of solid.

CO5- study the fundamental physical properties of mixing of one and two component system.

C-14 **COORDINATION CHEMISTRY** **CREDITS-05**

After completion of this course successfully the students will be able to

CO1- identify the bonding, structure and energy of selected coordination complexes.

CO2-perform applicationsof coordination compounds.

CO3- study the physical parameters of coordination compounds.

CO4- understanding the reaction mechanism in coordination compounds.

CO5- understanding the applications of spectral and magnetic properties of lanthanides and actinides.

C-15 **BASIC ANALYTICAL CHEMISTRY** **CREDITS-05**

After completion of this course successfully the students will be able to

CO1- apply amperometry technique in the characterization of metal ion

CO2- apply colometry for the identification and characterization.

CO3- understand and apply the conductometry for the characterization of metal ion

CO4- estimate metal ion using polarographic technique

CO5- estimate metal ion through voltammetry

C-16 **CHEMISTRY OF NATURAL PRODUCTS** **CREDITS-05**

After completion of this course successfully the students will be able to

CO1-understand the structure of selected plant pigments.

CO2- appreciate the importance of alkaloids.

CO3- understand the basic of terpenoids and carotenoids from local plants materials as natural products.

CO4- understand the isolation of steroids.

CO5-perform the synthesis of selected antibiotics and action of antibiotics as drugs.

C-17 **INTERDISCIPLINARY TOPICS** **CREDITS-04**

After completion of this course successfully the students will be able to

CO1- appreciate the importance of nanoscience and technology.

CO2- understand the role of green chemistry in chemical science.

CO3- study the concept of supra molecular chemistry and its applications.

CO4- understand the environment and atmosphere and the role of greenhouse effect, acid rain, air pollution in the environment.

CO5- understand the role of aquatic pollution and also study the hydrosphere and soils.

C-18 **SEPARATION TECHNIQUES** **CREDITS-04**

After completion of this course successfully the students will be able to

CO1- learn the applications of TLC and column chromatography in analysis of mixtures.

CO2- understand the principle, experimental setup and applications of partition.

CO3-acquaint the knowledge of GC in analysis of samples.

CO4- understand analyze and applications of HPLC and also applications of supercritical fluid and gel permeation chromatography.

CO5- learn the experimental setup and applications of solvent extraction.

C-19 **ADVANCED ANALYTICAL METHODS** . **CREDITS-04**

After completion of this course successfully the students will be able to

CO1- appreciate the importance of data analysis in chemistry.

CO2-analyze common metal using inductively coupled plasma spectroscopy.

CO3- familiarize with instrumentation and application of x-ray diffraction.

CO4-gather knowledge of scanning electron microscopy and transmission electron microscopy in analysis of samples.

CO5- study the fundamental applications of thermal gravimetric analysis of materials.

C-20ADVANCED INORGANIC CHEMISTRY **CREDITS-04**

After completion of this course successfully the students will be able to

CO1- advance learning of transition metal complexes in chemistry.

CO2-understanding of bio-inorganic metals in living system.

CO3- learning the role of metalloenzymes in biological system.

CO4- study the metal nucleic acid interaction as well as metal in biological systems.

CO5- known the excited states of metal complexes in coordination chemistry.

C-21 **ADVANCED ORGANIC CHEMISTRY** **CREDITS-04**

After completion of this course successfully the students will be able to

CO1- learning the basic of heterocyclic chemistry.

CO2- getting an idea about the mechanistic pathway of various common organic rearrangements.

CO3- understanding the concept and applications of pericyclic reactions in advanced organic chemistry.

CO4- learning the concept of disconnection approach in the designing and synthesis of complexed molecules.

CO5- understanding the structure and used of some important drugs.

C-22 ADVANCED PHYSICAL CHEMISTRY . **CREDITS-04**

After completion of this course successfully the students will be able to

CO1- understanding and appreciate the advanced concepts of thin film and Langmuir-Blodgett films and liquid crystal.

CO2- advanced study of polymeric materials and its applications.

CO3-study ionic conductors its properties and applications.

CO4- developing skill in computational treatment of atoms and molecules.

CO5- studying of general properties of liquids.

C-23 POLYMER CHEMISTRY **CREDITS-04**

After completion of this course successfully the students will be able to

CO1- understanding the basic importance of polymers.

CO2- developing skill in the polymer characterization.

CO3- evaluating the structure and various properties of crystalline polymer.

CO4- learning the process of polymerizations.

CO5- understanding the properties of commercial polymer and its applications.

C-24 INDUSTRIAL CHEMISTRY **CREDITS-04**

After completion of this course successfully the students will be able to

CO1- understanding and apply of cement, ceramic and glass.

CO2- learning the basic of composites formation and its application.

CO3- understanding the different fertilizer and its specific application.

CO4- knowing the utilization and preparation of petrochemicals and lubricants.

CO5- knowledge of paints and its formulation.

C-25 **MEDICINAL CHEMISTRY** . **CREDITS-04**

After completion of this course successfully the students will be able to

CO1- understanding the advanced knowledge of drug design and developments of new drugs.

CO2- studying of various pharmacokinetics of drugs and its applications in drug developments.

CO3- learning pharmacodynamics of drugs in medicinal chemistry.

CO4- understanding the drugs used as antineoplastic.

CO5- understanding the drugs used as cardiovascular drugs.

C-26 **M.Sc. CHEMISTRY PRACTICAL (SEMESTER X)** **CREDITS-04**

After completion of this course successfully the students will be able to

CO1- learn about the role of flame photometry in the analysis of metals.

CO2- learn about the spectroscopic and chromatographic technique in the analysis of substance.

CO3- evaluate the organic compound from natural resources.

CO4- learn the multistep and green synthesis of organic compounds.

CO5- utilization of thermodynamic spectroscopy, polarography in the analysis of sample.

C-27 **RESEARCH PROJECT** **CREDITS-08**

After completion of this course successfully the students will be able to

CO1- understand research problems specific topic.

CO2- execute literature search on a research topic assigned to students.

CO3- design new experiments to address research problems based on the allotted research topics.

CO4- conducts experiments in a scientific way.

CO5-analyze and interpretation of the results.

SEMESTER-VII

C-1 **COMPUTERS FOR CHEMISTS** **M.M. 75**

Credits-05

Unit I: History of Development of Computer, Classification of Computers, Generation of Computers, General Awareness of Computer Hardware – CPU and other peripheral devices, Input, Output and Auxiliary Storage Devices

Unit II: Softwares and their types (System Software & Application Software), Computer Language and their types (Low Level & High Level Languages), Operating System, requirement of OS, Types of OS : Single User and Multi-user OS with example

Unit III: **Computer and Internet 1:** What is Networking, Different types of Networking (LAN, WAN and MAN), Optical Fibres, Ethernet, Network Interface Card, Hub, Switch, Routers, Modems, Protocols TCP/IP, Internet Service Providers (ISP), Web Search Engine, Intranet, Difference between Internet & Intranet

Unit IV: Educational and Research Resources on Net for Chemical Sciences, Online Tutorials and Lectures Virtual Labs, Electronic Journals, E-books, Digital Libraries, Use of Chemdraws like tools for Chemical Education.

Unit V: MS Word, facilities in MS Word, MS- Excel, Facilities in MS Excel, MS PowerPoint, Oral Presentations using visual aids such as Power Point etc. Adobe Photoshop (Introductory), Multimedia, Digital Arts.

C-2 **INORGANIC CHEMISTRY** **M.M. 75**

Credits-05

Unit I: **Mechanism of inorganic reactions**:

Mechanisms of redox reactions of metal complexes, Substitution reactions of octahedral and square planar complexes in aqueous solutions, cis- and trans effects.

Unit II: **Nuclear Chemistry**:

Radioactive decay and equilibrium, Nuclear reactions and its types, Q-value, cross section of reactions, chemical effects of nuclear transformation. Nuclear fission–Fission products, Fission Yield and Nuclear Reactors, Nuclear Fusion and Stellar energy.

Radioactive techniques **(i)** Tracer techniques (neutron activation analysis)

(ii) Counter techniques such as G.M., Ionization and proportional counters

Unit III: **Metal clusters**:

Higher boranes, carboranes, metalloboranes, metallocarboranes, metal carbonyl and halide clusters. Compounds with metal-metal multiple bonds, Wade's rule, LNCC & HNCC, Caping rule.

Unit IV: **Chemistry of macrocycles**:

Complexes of crown ethers, porphyrins and cryptands, their synthesis, important characteristics with special reference to hole size and importance in biological systems.

Unit V: **Inorganic Polymers**:

Classification, characteristics and properties. Type of inorganic polymerization (step growth, chain growth, ring opening, reductive coupling, condensation synthesis). Synthesis, properties and applications of important inorganic polymers: polyphosphazines, phosphonitrilic halides, polysiloxanes, polysilanes, co-ordinate polymers, condensed phosphate, silicates and S-N compounds.

Books Suggested:

1. Advanced Inorganic Chemistry, F.A. Cotton and Wilkinson , John Wiley.
2. Inorganic Chemistry, J.E. Huhey, Harpes & Row.
3. Inorganic Electronic Spectroscopy, A.B.P. Lever, Elsevier.
4. Comprehensive Coordination Chemistry Eds G.Wilkinson, R.D. Gillars and J.AMcCleverty,Pergamo
5. Nuclear and Radioactivity- Friedlander G; Kennedy J.M Mamas E.S., Miller J.M., Wiley Inter Science N.Y. (1981).
6. Nuclear Reactions R. Singh & S. N. Mukherjee, New Age International. New Delhi.

C-3 ORGANIC CHEMISTRY M.M.75

Credits-05

Unit-I: (a) Delocalized chemical bonding – conjugation, cross conjugation, resonance, hyperconjugation, tautomerism.

(b) Reaction intermediates- Generation, geometry, stability and reactions of carbocations, carbanions, free radicals, carbenes, nitrenes and benzynes.

Unit-II: Substitution reactions:

SN^1, SN^2 SN^{1i} and SN^{2i} mechanisms, neighbouring group participation in aliphatic nucleophilic substitutions, Electrophilic and nucleophilic aromatic substitutions reactions.

Unit- III: Elimination reactions:

The E^1, E^2, E^1CB mechanisms, orientation in E^2 reactions (Saytezeff and Hoffman), Pyrrolyticsyn-elimination, Stereochemistry of elimination reaction.

Unit- IV: Common Organic Reaction and Mechanism

Aldol, Perkin, Dickmann condensation, Reformatsky, Benzoin, Wittig, Mannich reaction, Michael reaction, Diels-Alder reaction, Knoevengel reaction.

Unit- V: Reagents in Organic Synthesis:

Lithium aluminium hydride, Sodium borohydride, lithium dialkylcuprate, lithium di-isopropylamine, Grignard reagents, mono &dialkylboranes, 1,3-Dithiane, Gerard's reagent P & T, dicyclohexylcarbodimide, N-bromosuccinimide.

Books Suggested

1. Vogel's Text book of Quantitative Analysis, revised. J. Bassett, R. C. Denney. G.H. Jeffery and J. Mendham ELBS.

2. Experiments and Techniques in Organic Chemistry, D. Pasto. C. Johnson and M. Miller, Prentice Hall.

3. Macroscale and Microscale Organic experiments, K.L. Williamson. D.C. Heath.

4. Systematic qualitative Organic Analysis, H. Middleton, Adward Arnold.

5. Handbook of Organic Analysis Qualitative and Quantitative. H. Clark, Adward Arnold.

6. Vogel's text book of Practical Organic Chemistry, A.R. Tatchell, John Wiley.

7. Reaction and Reagents , O.P.Agrawal, Krishna Publication, Meerut.

C-4 **PHYSICAL CHEMISTRY** **M.M.75**

Credits-05

Unit-I : **Quantum Chemistry:**

Approximation Method:The variation theorem, Linear variation principles, Perturbation theory (First order and non degenerates), application of variation method and perturbation theory to be helium molecule.

Unit-II: **Statistical thermodynamics:** Chemical equilibria and equilibrium constant interms of partition function, Fermi-Diarc statistics, Distribution law and application of fomatal, Bose-Einstein statistics-distribution law and application to helium.

Unit-III: **Chemical Dynamics:** Methods of determining rate laws, collision theory of reaction rates, steric factor, activated complex theory, Arrhenius equation and the activated complex theory, ionic reaction, kinetic salt effects, steady state kinetics, kinetics and thermodynamic control of reaction, treatment of unimolecular reactions treatment of unimolecular reactions. Dynamic chain (hydrogen-bromine reaction, pyrolysis of acetaldehyde decomposition of ethane, Photochemical (hydrogen-bromine and hydrogen-chlorine reactions)

Unit-IV: **Micelles:** Surface active agents, classification of surface active agents, micellization, hydrophobic interaction, critical micellar concentration (CMC), factor-affecting the CMC of surfactants.

Macromolecules: Polymer-definition, types of polymers, electrically conducting, fire resistant, liquid crystals polymers, kinetics of polymerization, mechanism of polymerization.

Unit-V: **Electrochemistry:** Electrochemistry of solution, Debye-Huckel-Onsager treatment and its extension, ion solvent interaction, Debye-HuckelJerum mode, thermodynamic of electrified interface equation, over potential, exchange current density.

Book Suggested:

1. Physical chemistry, P.W. Atkins, ELBS
2. Introduction to Quantum chemistry, A.K. Chandra, Tata McGraw Hill.
3. Quantum chemistry, Era N Levine, Prentice Hall.
4. Coulson's Valence, R. McWeeny, ELBS.
5. Chemical Kinetics, K.J. Laidler, McGraw- Hill.
6. Kinetics and mechanism of chemical transformations, J. Rajaraman and J. Kuriacose, McMillan.
7. Micelles, Theoretical and applied aspect, V. Moroi, Plenum.
8. Modern electrochemistry, Vol. 1 and Vol. 2, J.O.M. Bockris and A.K.N. Reddy, Plenum.

C-5 ADULTERANTS (MINOR for Other Faculty) M.M. 75

Credits-04

Unit-I **Introduction**

Food and food for life, adulteration, types of adulteration, identification of adulterants, adulteration problems, common adulterants in food and their injurious effects on health

Unit-II **Detection of adulterants**

Qualitative Analysis : Qualitative macro, semi-micro and micro techniques involving wet chemical tests, flame tests, etc, microscopic examination
Quantitative Analysis : Titrimetric and gravimetric method, instrumental methods

Unit-III **Materials to be analysed**

Milk analysis: Detection of added water, neutrialzers, hydrogen peroxide, formalin, sugar, starch, urea, ammonium sulphate, salt, pulverized soap, detergents, skim milk powder, vegetable fat, benzoic acid, salicylic acid, boraxm borax, boric acid and buffalo milk in cow's milk

Khoya and Sweet analysis: Detection of starch (maida, etc) aluminium foil replacing silver foil in sweets, detection of washing powder in ice cream.

Spice analysis: Detection of added starch, lead chromate, Metanil yellow in temeric powder, powdered dung in coriander powder, identification of artificially coloured foreign seeds shown as cumin seed, poppy seed and black pepper

Unit-IV **False labelling and fake products in food packets:** How to read a food label, elements of a food label, list of ingredients, terms used in food labels, market survey and analysis of packaged product/materials. Hazards of reckless use of faulty food preservatives in food products

Unit-V **Creation of public awareness:** Dissemination of information about the "food safety and standard (Packaging and Labelling) Regulation, Act 2011". Creation of consumer awareness for checking food adulteration and about fake and spurious products through print and view media

SEMESTER-VIII

C-6 GROUP THEORY AND SPECTROSCOPY M.M. 75

Credits-04

Unit-I: Symmetry elements and symmetry operation, point groups and their classification with examples, sub groups. General methods of assigning point groups to a molecules like water (C_{2v}), ammonia (C_{3v}), phosphorous (D_{3h}) and Xenon tetrafluoride (D_{4h}).

Unit-II: Rotational and vibrational spectroscopy: Introduction, fundamental principle and applications

Unit-III: Electronic spectroscopy: Introduction, theory involving electronic transition and applications

Unit-IV: Atomic absorption spectroscopy: Introduction, principle, technique instrumentation and applications

Unit-V: Flame photometry: Introduction, principle, technique, instrumentation, interference and applications

Books Suggested:

1. Modern spectroscopy, J.M. Hollas, John Willey.

2. Applied Electronic Spectroscopy For Chemical Analysis. Ed.H, Windawi and F.L. Ho, Wiley Interscience.

3. NMR, NQR, EPR and Mossbauer Spectroscopy in Inorganic Chemistry, R.V. Parish, Ellis Harwood.

4. Physical Method in Chemistry, R.S. Drago, Saunders College.

5. Introduction to Molecular Spectroscopy, G.M. Barrow, Mcgraw Hill.

6. Basic Principles of Spectroscopy, R. Chang. McGraw Hill.

7. Theory and Application of UV Spectroscopy, H.H. Jaffe and M. Orchin, IBHOxford.

8. Introduction of Photoelectron Spectroscopy, P.K. Ghosh, John Wiley.

9. Introduction of Magnetic Resonance, A. Carrington and A.D. Maclachlan, Harper and Row.

C-7 **BIO-INORGANIC CHEMISTRY** **M.M.75**

Credits-04

Unit-I: **Metal ions in biology:**
Molecular mechanism of ion transport across membranes sodium and potassium pump, Essential and trace elements.

Unit-II: **Biomolecules:**
Structures and functions of metalloproteins in electron transport process - cytochromes and Iron-Sulphur proteins, DNA polymerisation, glucose storage.

Unit-III: **Bio-inorganic pigments:**
Chlorophyll, Photosystem-I and Photosystem-II in cleavage of water, haemoglobin, myoglobin, haemocyanin and hemerythrin. Storage of oxygen and its transport.

Unit-IV: **Bio-Chemistry:**
Biochemistry of calcium, copper and zinc. Biological Nitrogen fixation (Associative nitrogen fixation, symbiotic nitrogen fixation).

Unit-V: (a) Toxicity of metals (cadmium, mercury, lead, arsenic, copper). Deficiency of Metal ions
(b) Medicinal Inorganic chemistry- Metal ions and chelating agent in medicines. Drug activity, control of metal ion concentration, *In vivo* removal of metal ions, Antimicrobial drugs, anticancer drugs.

Books Suggested:

1. Progress in Inorganic Chemistry, vol. 18 and 38 Ed. J J. Lippard, Wiley.

2. Inorganic Biochemistry vol. I and II ed. G. L. Eichhorn, Elsevier.

3. Principles of Bioinorganic Chemistry, S. J. Lippard and J. M. Berg, University Science Books.

C-8 **BIO- PHYSICAL CHEMISTRY** **M.M.75**

Credits-04

Unit-I: Enzymes:

Introduction, nomenclature and classification, Fischer lock and key: Kosland and Induced hypothesis: Transition state theory, acid base catalysis, Nucleophilic displacement on phosphorous atom. Multiple displacement reaction and the coupling of ATP, cleavage to endergonic processes, Addition and Elimination reaction of enzyme catalyzed carboxylation and decarboxylation

Unit-II Coenzymes:

Apoenzymes, structure and biological function of coenzymes, production, purification of enzymes, methods of immobilization of enzyme activity, application of immobilized enzymes, clinical use of enzymes

Unit-III Bio-energetics:

Standard and free energy change in biochemical reactions, exergonic endergonic, hydrolysis of ATP, synthesis of ATP from ADP

Unit-IV Cell membranes and Transport of ions:

Structure and functions of cell membrane, ion transport through cell membrane, irreversible thermodynamics treatment of membrane transport, nerve conduction.

Unit-V Biopolymer Interactions:

Forces involved in biopolymer interactions, electrostatic charges and molecular expansion, hydrophobic forces, dispersion force interaction, multiple equilibrium and various types of binding processes in biological systems.

Books Suggested:

1. Understanding enzymes, Trevor Palmer, Prentice Hall.

2. Enzyme Mechanisms Ed, M. I. Page and A. Williams, RSC.

3. Fundamental ofEnzymology, N. C. Price and L. Stevens, Oxford University Press.

4. Biochemistry, L. Stryer, W.H. Freeman.

5. Macromolecules: Structure and Function, F. Wold. Prentice Wall. 6. Biochemistry, Voet and Voet, John Wiley

C-9 **SPECTROSCOPIC METHODS OF ANALYSIS** **M.M.75**

Credits-04

Unit I: **Absorption spectroscopy**

L-B's Law and its limitations, Einstein's two level transition model. Transition moment and its relation to molar extinction coefficient. Different types of transitions ($\pi\pi^*$, $\sigma\pi^*$, $n\pi^*$ etc.), Selection rules with symmetry arguments, Solvent perturbation method, Weak and CT transition, Vibronic and spin orbit coupling.

Unit II: **Raman Spectroscopy**

Classical and quantum theories of Raman Effect, pure rotational vibrational and vibrational-rotational, Raman spectra, Selection rules, Mutual exclusion principle, Resonance Raman spectroscopy, Coherent anti stokes raman spectroscopy (CARS)

Unit III: **Nuclear magnetic resonance spectroscopy (NMR):**

Introduction, Theory, relaxation process and saturation, environmental effects on NMR spectra, chemical shift, spin-spin splitting, factors influencing coupling constant 'J', Spin decoupling, basic ideas about instrument, NMR studies of nuclei other than proton ^{13}C, ^{19}F, and ^{31}P, FT-NMR advantages of FT-NMR, use of NMR in medical diagnostics.

Unit IV: **Mass Spectrometry:**

Introduction, molecule ion peak, base peak, isotopic abudance, metastable ions fragmentation mechanism of compounds containing C,H,O,N and halogen, Mac Lafferty rearrangement , nitrogen rule and ring rule and applications.

Unit V: **ESR Spectroscopy:**

Introduction, principle, hyperfine splitting, and significance of g-value, determination of δ - value. Rules for hyperfine splitting and applications.

Books Suggested:

1. Modern spectroscopy, J.M. Hollas, John Willey.

3. NMR, NQR, EPR and Mossbauer Spectroscopy in Inorganic Chemistry, R.V. Parish, Ellis Harwood.

5. Introduction to Molecular Spectroscopy, G.M. Barrow, Mcgraw Hill.

6. Basic Principles of Spectroscopy, R. Chang. McGraw Hill.

7. Theory and Application of UV Spectroscopy, H.H. Jaffe and M. Orchin, IBHOxford.

9. Introduction of Magnetic Resonance, A. Carrington and A.D. Maclachlan, Harper and Row.

C-10 M.Sc. CHEMISTRY Practical (Semester VIII) M.M.100

Credits-04

INORGANIC CHEMISTRY

(A) Qualitative and Quantitative Analysis: [20]

(i) Separation and determination of two metal ions Cu-Ni, Ni-Zn, Cu-Zn, etc. involving volumetric and gravimetric methods.

(B) Inorganic Preparations: [10]

(i) Reineckel Salt
(ii) Tetraamine Cupric Sulphate
(iii) Chrome Alum
(iv) Aluminium Chloride Hexahydrate
(v) Nickel Dimethyl Glyoxime
(vi) Sodium Cobalt Nitrate
(vii) Potassium Trioxalato Ferrate (III)
(viii) *Cis*-Potassium DioxalatoDiaqua Chromate
(ix) *Trans*-Potassium DioxalatoDiaqua Chromate $K[Cr(C_2O_4)(H_2O)_2].2H_2O$
(x) Prussian Blue

ORGANIC CHEMISTRY

(A) Qualitative Analysis: [10]

Separation, Purification and Identification of compounds of tertiary mixtures (three solids)

(B) Organic Synthesis: [10]

Sulphonation, Diazotization, Aldol Condensation, Friedel Crafts Reaction, Cannizzaro Reaction, Acetylation, Benzylation, Nitration.

(C) Quantitative Analysis: [10]

(a) Determination of percentage or number of Hydroxyl Groups in an organic compound by accetylation method.
(b) Estimation of amines/ Phenols using bromated bromide solution/ or acetylation method.

PHYSICALCHEMISTRY [30]

(1) To estimate hardness of water by ethylene diamine tetra-acetic acid (EDTA).
(2) To study the distribution co-efficient of benzoic acid between benzene and water.
(3) To determine the distribution co-efficient of iodine between water and CCl_4 at room temperature.
(4) To determine the specific reaction rate of the hydrolysis of methyl acetate/ ethyl acetate catalyzed by hydrogen ions at room temperature.
(5) To titrate the given mixture of CO_3 and HCO_3 ions against a strong acid (HCl) using p-meter and to determine the strength of it.
(6) To determine the amount of chloride ions present in the given KCl solution.
(7) To determine nickel as dimethyl glyoximate complex spectrophotometrically.
(8) Preparation of standard solution.
(9) Determination of proton coefficient between water and an organic solvent.
(10) To test the validity of lambert-Beer's Law (using methylene blue) and to determine

I. λmax
II. Molar extinction coefficient (€)

RECORD [05]

VIVA [05]

C-11 **RESEARCH PROJECT** **M.M.100**

Credits-08

The research project is based on the following topics –

1. Coordination Chemistry
2. Macro Cyclic Chemistry
3. Green Chemistry
4. Nano Chemistry
5. Pesticide Chemistry
6. Polymer Chemistry
7. Polymer Nano Composite
8. Environmental Science
    i. Air Pollution
    ii. Soil Pollution
    iii. Water Pollution
9. Natural Products
10. Synthetic Organic Chemistry
11. Drug Chemistry
12. Industrial Chemistry

SEMESTER-IX

C-12 PHOTO AND STEREOCHEMISTRY M.M. 75

Credits-05

Unit-I: General principles- Photochemical energy, Frank-Condon principle, Jablonski diagram, singlet and triplet states, photosensitization, quenching, quantum efficiency and quantum yield, energy transfer process in photochemistry, experimental methods of photochemistry.

Unit-II: Photochemistry of carbonyl compounds, Norrish type-I and Norrish type-II cleavages, Paterno-Buchi reactions, photoreductions, photochemistry of unsaturated systems like olefins, cis-trans isomerisation, dimerizations, hydrogen abstraction, addition. Photochemistry of enones-rearrangement of unsaturated ketones and cyclohexadienones.

Unit-III: A) Concept of chirality, elements of symmetry, R-S nomenclature, E-Z isomerisms. Interconversion of Fischer, Newman and Sawhorse projections

B) Conformation and reactivity in acyclic compound (upto four C-atoms) and cycloalkanes (upto cyclohexane)

C) Transannular effects in medium sized ring compounds.

Unit-IV: Molecular dissymmetry and chiroptical properties, linear and circularly polarized light, circular birefringences and circular dichroism, ORD and CD curves. Plain and Cotton effect curves and their applications. The octant rule and axial haloketone rule with applications

Unit-V: A) Racemates and their classification, method of resolution of recemates.

B) Chemoselectivity, regioselectivity, stereoselective, stereospecific reactions and enantioselectivity with examples.

Books Suggested:

1. Fundamental of Photochemistry, K. K. Rohtagi-Mukherji, Wiley-Eastern.
2. Molecular Photochemistry, N.J. Turro, W. A. Benjamin.
3. Organic Photochemistry, J. Coxon and B. Halton, Cambridge University Press.
4. Photochemistry, R P. Kundall and A. Gilbert, Thomson Nelson
5. Stereoselective Synthesis: A Practical Approach M.Nogradi, VCH.

C-13 SOLID STATE CHEMISTRY, SURFACE PHENOMENON AND CHEMICAL EQUILIBRIA. M.M.75

Credits-05

Unit-I : Solid State

Crystalline state of solids, unit cells and Bravais lattices, Miller indices, Diffraction of X-rays by crystalline solids, fundamental aspects of X-ray, electron and neutron diffraction studies

Unit-II : Crystal Defects and Non- Stoichiometry

Perfect and imperfect crystals, intrinsic and extrinsic defects-point defects, line and plane defects, vacancies-Schottky defects and frenkeldefects, structural imperfections and properties of solids such as ionic conductivity, diffusion, ferroelectric properties and luminescence, non-stiochiometry and defects.

Unit-III : Electronic properties and Band theory

Metals, insulators and semiconductors, electronic structure of solids-band theory, band structure of metals, insulators and semiconductors, intrinsic and extrinsic semiconductors, doping semiconductors, p-n junctions, superconductors,

Unit-IV : Surface Phenomenon

Surface tension, adsorption on solids, electrical phenomena at interfaces, including electrokinetic, micelles and reverse micelles: solubilization, micro-emulsion, application of photoelectron spectroscopy, ESCA and Augor spectroscopy to the study of surfaces.

Unit-V : Chemical Equilibria

Free energy and entropy of mixing, partial molar quantities, Gibbs-Duhemequation. Equilibrium constant, temperature- dependence of equilibrium constant, phase diagram of one- and two component systems, phase rule.

Books Suggested:

1. Solid State Chemistry and its Application, Anthony R. West, Wiley Publication, US
2. Solid State chemistry an Introduction, Lesley E.Smart and Elaine A.Moore,Taylor and Francis,London.
3. Principles of Physical Chemistry, Puri, Sharma and Pathania, Vishal Publising, Delhi

C-14 **COORDINATION CHEMISTRY** **M.M.75**

Credits-05

Unit I : Crystal field theory, crystal field splitting of d-orbitals in octahedral, tetrahedral and square planar complexes, crystal field stabilization energy (CFSE) in octahedral (weak and strong fields) and tetrahedral complexes, factor affecting CFSE and uses of CFSE, spectrochemical series.

Unit-II : **(a)** Applications of CFT in colour of transition metal complexes, limitations of CFT, valence bond theory and comparison of VBT and CFT.

(b) Ligand field theory, evidences of covalance and adjusted crystal field thery (ACFT), molecular orbital treatment of octahedral complexes and bonding, molecular orbitals for tetrahedral and square planar complexes, spin cross over coordination compounds.

Unit III : Coordination chemistry of transition metal ions, stability constants of complexes and their determination; stabilization of unusual oxidation states. Stereochemistry of coordination compounds. Jahn-Teller effect; Interpretation of electronic spectra including charge transfer spectra; nephelauxetic series, magnetism: Dia -, para -, ferro – and anti-ferromagnetism quenching of orbital angular moment, spin orbit coupling.

Unit-IV : Inorganic reaction mechanism; substitution reactions, trans effect and electron transfer reactions, photochemical reaction of chromium and ruthenium complexes. Fluxional molecules, iso- and heteropoly acid, metal clusters spin crossover in coordination compounds.

Unit-V : **Studies and Applications of Lanthanides and Actinides:**

Spectral and magnetic properties, Modern methods of separation of lanthanides and actinides. Organometallic compound of lanthanides, Applications of lanthanides and actinides compounds in industries. Use of lanthanides compounds as Shift's reagent.

Books Suggested:

1. Advanced Inorganic Chemistry, F.A. Cotton and Wilkinson , John Wiley.
2. Inorganic Chemistry, J.E. Huhey, Harpes & Row.
3. Inorganic Electronic Spectroscopy, A.B.P. Lever, Elsevier.
4. Comprehensive Coordination Chemistry Eds G.Wilkinson, R.D. Gillars and J.AMcCleverty,Pergamo
5. Synthesis and Characterization of Inorganic compounds, W.L. Jolly, Prentice Hall,
6. Concise Inorganic Chemistry, J.D.Lee, Wiley Publication

C-15 **BASIC ANALYTICAL CHEMISTRY** **M.M. 75**

(Elective-1) *Credits-05*

Unit-I : **Amperometry:** Introduction, principle, types of current, technique, amperometric titrations with DME, amperometric titrations with rotating platinum micro electrode, biampero-metry, applications.

Unit-II : **Coulometry:** Introduction, constant current coulometry, controlled potential coulometry (principle and technique), types of coulometer, applications.

Unit-III : **Conductometry:** Introduction, principle, technique, electrolytic conductivity, measurement of electrolytic conductivity, conductometric titration, applications.

Unit-IV : **Polarography :** Introduction, principle, technique, D.M.E., half-wave potential, residual current, migration current, diffusion current, limiting current, applications.

Unit-V : **Voltammetry :** (a) Introduction, principle, technique and applications

(c) Cyclic voltammetry and anodic stripping voltammetry.

Books Suggested

1. Instrumental Method of Chemical Analysis, B.K. Sharma, Krishna Prakashan, Media, Meerut.
2. Instrumental Method of Chemical Analysis, Gurdeep Chatwal, Himalaya Publication House, New Delhi.
3. Instrumental Method of Chemical Analysis, H. Kaur, Pragati Prakashan, New Delhi
4. Instrumental Method of Analysis, Willard, Meritt, Dean, Wadsworth Publishing Co. Inc, Australia
5. Basic Concept of analytical Chemistry, S.M. Khopkar, New Age International Publisher, New Delhi.
6. Fundamental of Analytical Chemistry, Holler and Crouch, Brooks Cole, US.

C-16 **CHEMISTRY OF NATURAL PRODUCTS** **M.M.75**

(Elective-2) *Credits-05*

Unit-I : **Plant Pigments:**

Introduction, occurrence, general methods of structure determination, isolation and synthesis of apigenin, luteolin, vitexin, myrcetin, quercetin, lycopene, aureusin, cyanidin, hirostidin.

Unit-II : **Alkaloids**:

Introduction, classification, occurrence, isolation of alkaloids, general methods of determination of structure of alkaloids, Constitution and synthesis of cocaine, nicotine, atropine, morphine, reserpine. Biosynthesis of alkaloids.

Unit –III : **Terpenoids and Carotenoids:**

Introduction, classification, occurrence, general methods of structure determination, isoprene rule, constitution and synthesis of citral, zingiberene, farnesol, bisabolene, β- carotenoids, Biosynthesis of terpene.

Unit-IV : **Steroids**:

Introduction, classification, occurrence, isolation, constitution and synthesis of cholesterol, testosterone, progesterone, androsterone. Biosynthesis of steroid.

Unit-V: **Antibiotics:**

Introduction classification, synthesis of penicillin-G, penicillin-V, amoxycillin, tetracyclin, chloramphenicol, streptomycin.

Books Suggested:

1. Natural Products: Chemistry and Biological Significance J. Mann, R.S. Davidson, J.B. Hobbs, D.V. Banthrope an J.B. Harborne, Longman Essex

2. Organic Chemistry, Vol 2, I L. Finar. ELBS.

3. Rodd's Chemistry of Carbon Compounds, Ed, S. Coffe Elsevier.

4. Chemistry, Biological and Pharmacological Properties of Medicinal Plants from the Americas, Ed. Kurt Hostettmann, M.P. Gupta and A. Marston, Harwood Academic Publishers.

5. Introduction to Flavonoids, B.A. Bohm, Harwood Academic Publishers.

6. New Trends in Natural Product Chemistry, Atta-Ur-Rahman and M.I. Choudhary, Harwood Academic Publishers.

7. Insecticides of Natural Origin, Sukh Dev, Harwood Academic Publishers

SEMESTER-X

C-17 **INTERDISCIPLINARY TOPICS** **M.M. 75**

Credits-04

Unit I : **Chemistry in Nanoscience and Technology**

Introduction to nanotechnology, scope of applications, techniques for synthesis of nano particles, important nano materials (Nano optics, Nano magnetic, Nano electronics) carbon nanotubes (types, properties and applications)

Unit II : **Catalysis and Green Chemistry:**

Introduction to green chemistry, principles of green chemistry, designing and chemical synthesis, examples of green synthesis / reactions, future trends in green chemistry.

Unit III : **Supra Molecular Chemistry:**

Introduction, concept and language, molecular recognition, supra molecular reactivity and catalysis, transport processes and carrier design.

Unit IV : **Environment and Atmosphere:**

Environmental chemistry, chemical composition of atmosphere – particles, ions and radicals and their formation. Heat budget of the earth atmospheric system, vertical stability of atmosphere, chemical and photochemical reactions in atmosphere, smog formation, oxides of N, C, S, O and their effect, green house effect, acid rain, air pollution controls and their chemistry.

Unit V: **Environmental chemistry (Hydrosphere and soils):**

Aquatic pollution – inorganic, organic, pesticide, agricultural, industrial and sewage, detergents, oil spills and oil pollutants, water quality parameters, water quality standards, purification and treatments of waste. Soil composition, micro and macro nutrients, pollution – fertilizers and pesticides, waste treatment.

Books Suggested:

1 A Text Took of Nanoscience and Nanotechnology, Mc Graw Hill Education, New York
2 Principles of Physical Chemistry, Puri, Sharma and Pathania, Vishal Publising, Delhi
3 New Trends in Green Chemistry, V.K. Ahluwalia, Springer, New York.
4 Environmental Chemistry, H.Kaur, Pragati Prakashan, Meerut

C-18 SEPARATION TECHNIQUES M.M. 75

Credits-04

UNIT I- **Adsorption Chromatography:** Principles, classification, experimental set up and applications of TLC and column chromatography.

UNIT II- **Partition Chromatography:** Principles, classification, experimental set up, special features, mechanism of separation procedures, advantages and disadvantages, and applications liquid-liquid and reverse phase partition chromatography, paper chromatography, thin layer chromatography (TLC) and ion pair chromatography.

UNIT III- **Gas Chromatography (GC):** Principles, classification, experimental set up, special features, mechanism of separation procedures, advantages and disadvantages, and applications Plate theory, gas-solid and gas-liquid chromatography, Hyphened technique. GC-MS and its applications.

UNIT IV- **HPLC:** Principles, classification, experimental set up, special features, mechanism of separation procedures, advantages and disadvantages, and applications Super critical fluid chromatography, gel permeation chromatography and molecular sieves.

UNIT V- **Solvent Extraction:** Principles, classification, experimental set up, special features, mechanism of separation procedures, advantages and disadvantages, and applications Extraction equilibria, partition coefficient and extraction coefficient, extraction by chelation and solvation; solid-phase extraction (SPE).

Books Suggested:

1. Instrumental Method of Chemical Analysis, B.K. Sharma, Krishna Prakashan, Media, Meerut
2. Instrumental Method of Chemical Analysis, Gurdeep Chatwal, Himalaya Publication House, New Delhi
3. Instrumental Method of Chemical Analysis, H. Kaur, Pragati Prakashan, New Delhi
4. Instrumental Method of Analysis, Willard, Meritt, Dean, Wadsworth Publishing Co. Inc, Australia
5. Basic Concept of analytical Chemistry, S.M. Khopkar, New Age International Publisher, New Del

C-19 ADVANCED ANALYTICAL METHODS M.M.75

(Elective-1) *Credits-04*

Unit I : **Data Analysis :** Errors, classification of errors, mean deviation and standard deviation, accuracy precision, rejection of measurements, confidence interval tests significance, error curve, minimization of errors, significant figures and computation of results, certified reference material and standard reference material.

Unit II : Principle, Instrumentation, Applications of Inductively Coupled Plasma (ICP) Spectroscopy.

Unit III : Principle, Instrumentation, Applications of X-Ray Diffraction (XRD)

Unit IV : Principle, Instrumentation, Applications of Scanning Electron Microscopy (SEM) & TEM

Unit V : **TGA :** Introduction, principal, instrumentation, Curie point, factor affecting the TGA curves and applications & DTA

Books Suggested:

1. Instrumental Method of Chemical Analysis, B.K. Sharma, Krishna Prakashan, Media, Meerut
2. Instrumental Method of Chemical Analysis, Gurdeep Chatwal, Himalaya Publication House, New Delhi
3. Instrumental Method of Chemical Analysis, H. Kaur, Pragati Prakashan, New Delhi

4 Instrumental Method of Analysis, Willard, Meritt, Dean,Wadsworth Publishing Co. Inc, Australia

C-20 **ADVANCED INORGANIC CHEMISTRY** **M.M. 75**

(Elective-2) *Credits-04*

Unit I- **(i) Transition metal π- complexes :** Transition metal π- complexes with unsaturated organic molecules, alkenes, alkynes, allyl, diene, dienyl, arene and trienyl complexes, preparations, properties, nature of bonding and structural features. Important reactions relating to nucleophilic and electrophilic attack on ligands and to organic synthesis.

(ii) Transition metal compounds with bonds to hydrogen.

Unit II- (i) Metal Storage Transport and Biomineralizations, Ferritin, Transferrin and Siderophores.

(ii) Calcium in Biology : Calcium in living cells, Transport and regulation, molecular aspects of intramolecular processes, extracellular binding proteins.

Unit III- **Metalloenzymes :** Zinc enzymes- Carboxypeptidase and carbonic anhydrase, Iron enzymes-catalase, peroxidase and cytochrome P-450. Copper enzymes-superoxide dismutase molybdenum oxatransferase enzymes-xanthine oxidase. Coenzyme Vitamin B_{12}.

Unit IV- **(i) Metal Nucleic Acid Interactions :** Metal ions and Metal complex interaction, metalcomplexes-nucleic acids.

(ii) Metal in Medicine : Metal deficiency and disease, toxic effect of metals, metals used for diagnosis and chemotherapy with particular reference to anticancer drugs.

Unit V- **Excited states of Metal Complexes :** Excited states of metal complexes comparison with organic compounds, electronically excited states of metal complexes, charge-transfer spectra, charge transfer excitations, methods for obtaining charge -transfer spectra.

Books Suggested:

1. Advanced Inorganic Chemistry, F.A. Cotton and Wilkinson , John Wiley.
2. Inorganic Chemistry, J.E. Hubey, Harpes & Row.
3. Inorganic Electronic Spectroscopy, A.B.P. Lever, Elsevier.
4. Comprehensive Coordination Chemistry Eds G.Wilkinson, R.D. Gillars and J.AMcCleverty,Pergamo
5. Synthesis and Characterization of Inorganic compounds, W.L. Jolly, Prentice Hall.

C-21 **ADVANCED ORGANIC CHEMISTRY** **M.M.75**

(Elective-3) ***Credits-04***

Unit I : **Heterocycles:**

Introduction, classifications, IUPAC names of mono and bicyclic hetero aromatic compounds. Criteria of aromaticity in heterocycles. Synthesis and reaction of benzo [b] and benzo [c], benzodiazoles and acridines, pyrazole, imidazole oxazole, thiazole, indole, pyrimidine.

Unit II : **Common Organic Rearrangements and their mechanism:**

Pinacol- Pinacolone, Wagner- Meerwein, Demjanove Beckmann, Hoffmann, Curtius, Schmidt, Lossen, Sommelet-Hauser, Favoroskii and Baeyer- Villiger rearrangement.

Unit III : **Pericyclic Reactions:**

Classification and examples, Woodword-Hofmann's Rule, Electrolytic reaction, Cycloaddition reaction ([2+2] and [4+2] only) and Sigmatropic shifts [1,3]- shift, [1,5]-shift and [3,3]- shift (Cope rearrangement and Claisen rearrangement), FMO approach only.

Unit IV : **Disconnection Approach**

Introduction to disconnection approach, FGI (Functional Group Interconversion), Synthon, Guidelines for order of events in disconnection, use of protecting group in disconnection approach

Unit V : **Drugs**

Antibacterials Drugs:-Introduction, preparation and uses of sulphanilamide, sulpha pyridine, sulphathiazole, sulpha guanidine.

Antihistaminic Drugs:- Introduction, preparation and uses of Benadryl, dimenhydrinate, antergan, pyribenzamine.

Anti-inflammatory:- Introduction, Preparation and uses of Steroid and non-steroid drugs (Ibuprofen, mefanamic acid, diclofenac)

Antimalarials:- Synthesis of mepacrine, chloroquin, Pamaquin, paludrin.

Books Suggested:

1. Heterocyclic Chemistry Vol. 1-3, R. R. Gupta, M. Kumar and V. Gupta. Springer Verlag.

2. The Chemistry of Heterocycles, T. Eicher and S. Hauptmann, Thieme.

3. Heterocyclic Chemistry, J.A. Joule, K. Mills and G. F. Smith, Chapman and Hall.

4. Heterocyclic Chemistry, T. L. Gilchrist, Longman Scientific Technical

5 The Organic Chemistry of Drug Design and drug Action, R.B. Silverman, Academic Press.

6. Strategies for Organic Drug Synthesis and design. D. Leilnicer. John Wiley.

C-22 ADVANCED PHYSICAL CHEMISTRY MM : 75

(Elective-4) *Credits-04*

Unit I – **Thin Film and Langmuir-Blodgett Films :** Preparation techniques, evaporation/sputtering, chemical processes, MOCVD, Sol-gel, etc. Langmuir –Blodgett (LB) films, growth techniques, Photolithography, properties and application of thin & LB films.

Liquid Crystal : Mesmorphic behavior, thermotropic liquid crystal, positional order, bond orientation order nematic and smetic mesophates, smetic-nematic, transition and clearing temperature, homeotropic, planar and schlieren textures, twisted nematics, chiral nematics, molecular arrangement in smetic A and smetic C phases, Optical properties of liquid crystal, Dielectric description of ordering in liquid crystals.

Unit II – **Polymeric Materials :** Molecular shape, structure and configuration, crystalinity, stress-strain behaviour, thermal behaviour, polymer types and their application, conducting and feno-electric polymers.

Unit III **Ionic Conductors :** Types of ionic conductors, mechanism of conduction, interstitial jumps (Frenkel); Vacancy, mechanism, diffusion superionic conductor, phase transitions and mechanism of conduction in super ionic conductors, examples and application of ionic conductors.

Unit IV – Theoretical and computation treatment of atoms and molecules, Hartree-Fock theory. Review of the principles of quantum mechanics, Born –oppen heimer approximation, Staler Condon rules. Hartree Fock equation, Koopmans and Brilloning theories, Roothan equation, Gaussian sets.

Unit V– **General Properties of Liquids :**

(a) Liquids as dense gases, liquids as disordered solids, some thermodynamic relation, internal pressures and its significance in liquids. Equation of state, critical constants. Different types of intermolecular forces in liquids, different potential function for liquids, additivity of pair potential approximation.

(b) A classical partition function for liquids, correspondence principle, configuration integral, configuration properties.

Book Suggested:

1. Physical chemistry, P.W. Atkins, ELBS

2. Advanced Physical Chemistry, Gurdeep Raj, Goel Publishing House, Meerut.

3. Principles of Physical Chemistry, Puri, Sharma and Pathania, Vishal Publising, Delhi

4. Solid State Physics ,N. W. Aschcroft and N.D. Mermin , Holt, Rinehart and Winston, New York, 1976.

5. Textbook of Polymer Science, F. W. Billmeyer. Jr.Wiley

C-23 — **POLYMER CHEMISTRY** — **M.M.75**

(Elective-5) — *Credits-04*

Unit-1 Basics Importance of polymers basic concepts; Monomers, repeat units, degree of polymerization, Linear, branched and network polymers, classification of polymers. Polymerization : condensation, addition, radical chain-ionic and co-ordination and copolymerization. Polymerization conditions and polymer reactions. Polymerization in homogeneous and heterogeneous systems.

Unit-II. Polymer Characterization Polydispersion - Average molecular weight concept. Number, weight and viscosity average molecular weights. Polydispersity and molecular weight distribution. The practical significance of molecular weight. Measurement of molecular weights. Endgroup, viscosity, light scattering, osmotic and ultracentrifugation methods Analysis and testing of polymers-chemical analysis of polymers, spectroscopic methods, X-ray diffraction study, Microscopy. Thermal analysis and physical testing-tensile strength. Fatigue. impact. Tear resistance. Hardness abrasion resistance.

Unit-III. Structure and Properties Morphology and order in cryststalline polymers-configurations of polymer chains. Crystal structures of polymers Morphology of cryststalline polymers, strain-induced morphology, crystallization and melting. Polymer structure and physical propertiescrystalline melting point Tm. melting points of homogeneous series, effect of chain flexibility and other steric factors, entropy and heat of fusion. The glass transition temperature, Tg relationship between Tm and Tg effects of molecular weight diluents, chemical structure, chain topology, branching and cross linking, property requirements and polymer utilization.

Unit- IV. Polymer Processing Plastics, Elastomers and fibres. Compounding Processing Techniques; Calendering, Die casting, rotational casting. Film casting, injection moulding, blow moulding, extrusion moulding, thermoforming, foaming, reinforcing and fibre spinning.

Unit-V. Properties of Commercial Polymers Polyethylene, polyvinyl chloride, polyamides, polyesters, phenolic resins, epoxy resins and silicon polymers. Functional polymers - Fire retarding polymers and electrically conducting polymers. Biomedical polymers-contact lens, dental polymers artificial heart, kidney, skin and blood cells.

Books Suggested:

1. Textbook of Polymer Science, F. W. Billmeyer. Jr.Wiley.
2. Polymer Science. V. R. Gowarikar, N.V. Viswanathan and J. Sreedhar, Wiley - Eastern.
3. Functional Monomers and Polymers , K. Takemoto, Y. Inaki and R.M. Ottanbrite.
4. Contemporary Polymer Chemistry, H.R. Alcock and F.W. Lambe, Prentice Hall.
5. Physics and Chemistry of polymers, J.M.G. Cowie, Blackie Academic and Professional.

C-24 | **INDUSTRIAL CHEMISTRY** | **M.M.75**

(Elective-6) | *Credits-04*

Unit 1: Cement, Ceramic and Glass Composition of cement, mixing of cement clinker with Gypsum, Setting of cement. Composition, Physical and Chemical properties of Glass, Varieties of glass, Introduction to ceramics.

Unit 2: Composites Introduction, constituents of composites, Types, of composites, Microscopic and Macroscopic Composites, Dispersion, Strength, Particle and Fiber- reinforced Composites.

Unit 3: Fertilizers N - Ammonia, Ammonium nitrate and Urea; P - Phosphoric acid, Single and Triple superphosphate, DAP; K- Potassium Nitrate and Muriate of potash.

Unit 4: Petrochemicals and Lubricants Introduction, Occurrence, Composition of Petroleum, Natural gas, cracking, refining, octane rating, cetane number, flash and fire point determination. Lubricating oils and additives, Naphtha crackers and Profile of their products, Synthetic and Blended oils.

Unit 5: Paints General characteristic, their function, Manufacture and Classification, Enamels, Emulsion paints, Water based paints. Formulation of paints: Function of vehicles, solvent, thinner, pigment, dyes, filler, resins, drier, insecticides, additives in paint formulation.

Books Suggested:

1. Molecular Magnetism, Oliver Kahn, VCH Publishers, UK,1993.
2. Materials Science and Engineering: An Introduction, W.D. Callisters,Wiley, 2006.
3. Solid State Physics ,N. W. Aschcroft and N.D. Mermin , Holt, Rinehart and Winston, New York, 1976.
4. Materials Science,J.C. Anderson, K.D. Leaver, J.M. Alexander and R.D. Rowlings . ELBS, 2003.
5. Hand Book of Liquid Crystals, Kelker and Hatz , 2nd Ed. Wiley, 2014.
6. Basics of Paint Technology, V.C. Malshe and Meenal Sikchi, Part I & II, 2008,
7. Introduction to Paint Chemistry, G.P.A. Turner, Chapman& Hall, 1967.

C-25 **MEDICINAL CHEMISTRY** **M.M.75**

(Elective-7) *Credits-04*

Unit-I Drug Design Development of New Drugs, Procedures followed in drug Design, Concepts of Lead Compound and Lead Modification, Concepts of Prodrugs and Soft Drugs, structure activity relationship (SAR), factors affecting bioactivity, resonance, inductive effect, isosterism, bio-isosterism, spatial considerations. Theories of drug activity : occupancy theory, rate theory, induced fit theory. Quantitative structure activity relationship. History and development of QSAR. Concepts of drug receptors, Elementary treatment of drug receptor interaction. Physico-chemical parameters: Lipophilicity, partition coefficient, electronic ionization constants, Steric, Shelton and surface activity parameters and Redox Potentials.

Unit-II Pharmacokinetics Introduction to drug absorption, disposition, elimination using pharmacokinetics, important pharmacokinetic parameters in defining drug disposition and in the rapeutics. Mention of uses of pharmacokinetics in drug development process.

Unit-III Pharmacodynamics Introduction, elementary treatment of enzyme stimulation, enzyme inhibition sulphonamides membrane active drugs, drug metabolism, xenobiotics biotransformation, significance of drug metabolism in medicinal chemistry.

Unit-IV Antineoplastic Agents Introduction, cancer chemotherapy, special problems, role of alkylating agents and antimetabolites in treatment of cancer. Mention of carcinolytic antibiotics and mitotic inhibitors.

Unit-V Cardiovascular Drugs Introduction, cardiovascular diseases, drug inhibitors of peripheral sympathetic function, central intervention of cardiovascular output. Direct acting arteriolar dilators. Synthesis of amyl nitrate, sorbitrate and diltiazem.

Books Suggested:

1. Introduction to Medicinal Chemistry, A. Gringuage, Wiley-VCH
2. Wilson And Gisvold Es Text Rook of Organic Medicinal and Pharmaceutical Chemistry. Ed. Robert F.Dorge.
3. An Introduction to Drug Design, S.S. Pandeya and J.R. Dimmock, New Age International. 4. Burger's Medicinal Chemistry and Drug Discovery, Vol-1(Chapter-9 and Ch-14), Ed. M.E. Wolff, John Wiley.
4. Goodman and Gilman's Pharmacological Basis of Therapeutics, McGraw-Hill.
5. The Organic Chemistry of Drug Design and drug Action, R.B. Silverman, Academic Press.
6. Strategies for Organic Drug Synthesis and design. D. Leilnicer, John Wiley.

C-26 M.Sc. Chemistry Practical (Semester X) [M.M. 100]

Credit 4

M.Sc. (Inorganic Chemistry) Practical

1. Flame Photometric Determinations

(a) Sodium and Potassium when present together

(b) Li/ Ca/ Ba/ Sr

(c) Cd and Mg in tap water

2. Spectrophotometric Determinations

(a) Fluoride/ Nitrite/ Phosphate

(b) Copper-Ethylene diamine complex; slope ration method

3. Chromatographic Separations

(a) Cd and Zn

(b) Zn and Mg

(c) Thin-layer chromatography

Separation of Ni, Mn, Co & Zn Determination of Rf values

M.Sc. (Organic Chemistry) Practical

1. Extraction of Organic compounds from natural resources: (One exercise) **[20]**

(i) Isolation of lactose from milk.
(ii) Isolation of casein from milk.
(iii) Isolation of caffeine from tea leaves.
(iv) Isolation of β- carotene from carrot.
(v) Isolation of lycopene from tomatoes.
(vi) Isolation of cystine fromhuman hair.
(vii) Isolation of Nicotine from tobacco.

2. Multi- step synthesis of organic compounds: (One exercise) **[20]**

(i) Preparation of p- Bromoaniline fromAniline (Bromination)
(ii) Preparation of p-nitroaniline from Aniline (Nitration)
(iii) Preparation of quinoline from aniline (Skraup Synthesis)
(iv) Preparation of 2- phenyl indole from phenyl hydrazine (Fischer- Indole synthesis)
(v) Benzoyl chloride to Benzaniline (Benzoylation)
(vi) Benzene to Acetanilide (Acetylation)

3. Green chemistry: (One exercise) **[15]**

(i) Coenzyme catalysed benzoin condensation (Thiamine hydrolysed catalysed synthesis of benzene)
(ii) Electrophilic aromatic substitution reaction-I (Nitration of Phenol)
(iii) Radical coupling reaction (Preparation of 1,1-Bis-2-naphthol)
(iv) Three component coupling (Synthesis of dihydropyrimidinone)
(v) Transestrification reaction (Synthesis of biodiesl)

(vi) Preparation of Iron (III) acetylacetonate.

4. Paper chromatography, separation and Identification of sugars present in glucose, fructose, sucrose by paper chromatography and determination of Rf values / TLC. [15]

5. Spectrophotometric estimation/Identification: (One exercise) [20]

(i) Asprin, disprin, Sprintas
(ii) Caffeine
(iii) Ascorbic Acid (Lemon, Amla)
(iv) Carbohydrate (Glucose, Sucrose, Fructose)
(v) Amino acids

M.Sc. (Physical Chemistry) Practical

Number of hours for each experiment 3-4 hours.

A list of experiment under different headings are given below.

Typical experiments are to be selected from each type

1. Thermodynamics :

(i) Determination of partial molar volume of solute (e.g. KCl) and solvent in a binary mixture.

(ii) Determination of the temperature dependence of the solubility of a compound in two solvents having similar intermolecular interaction (benzoic acid in water & in DMSO water mixture) and calculate the partial molar heat of solution.

2. Spectroscopy :

(i) Determination of pka of an indicator (e.g. Methyl red) in (a) aqueous and (b) micellar media

(ii) Determination of stoichiometry and Stability constant of inorganic (e.g. ferric-salicylin acid) and organic (e.g. amine iodine) complexes.

(iii) Characterization of the complexes by electronic and IR Spectral Data.

3. Polarography :

(i) Estimation of Pb^{2+} and Cd^{2+}/Zn^{2+} and Ni^{2+} ions in a mixture of Pb^{2+} and Cd^{2+}/Zn^{2+} and Ni^{2+} by Polarography.

(ii) Determination of dissolved oxygen in aqueous solution of organic solvents.

4. Electronics :

(i) Measurements of resistance with multimeter and calculate the colour code.

(ii) To measure the resistance of the given ammeter.

(iii) To study the characteristics of light emitting diode.

(iv) To study the characteristics of Zener diode.

(v) To study the characteristics of FET

(vi) To plot the characteristics curve of a diode.

(vii) Setting up of a thermostat: Constant temperature both.

RECORD [05]

VIVA [05]

C-27 **RESEARCH PROJECT** **M.M.100**

Credits-08

The research project is based on the following topics –

1. Coordination Chemistry
2. Macro Cyclic Chemistry
3. Green Chemistry
4. Nano Chemistry
5. Pesticide Chemistry
6. Polymer Chemistry
7. Polymer Nano Composite
8. Environmental Science
   i. Air Pollution
   ii. Soil Pollution
   iii. Water Pollution
9. Natural Products
10. Synthetic Organic Chemistry
11. Drug Chemistry
12. Industrial Chemistry

Programme Outcomes

Ensures the students to understand, acquire knowledge in Quantum Chemistry, Group Theory Symmetry, Photochemistry, Advanced Concepts in Spectroscopy, Polymer Science, Green Chemistry, Solid State, Natural Products, disconnection approach as well as role of Modern Synthetic Reagents in Organic Transformations, Nanotechnology, Thermodynamics, Advanced Chemical Kinetics, Surface Analytical Techniques to measure Surface Properties of materials and the Advanced Principles of various Electrochemical Techniques and all branches of Chemistry. This syllabus also ensures the students to understand acquire knowledge and have hands on experience in multistep Inorganic/ Organic Compound Synthesis and Analysis by using Spectroscopic Techniques and have hands on experience in multistep Organic Synthesis and Analysis by using Spectroscopic Techniques.

POST GRADUATE DIPLOMA IN RESEARCH(PGDR)

Desiged under NEP 2020 and based on CBCS

w.e.f session 2022-23

Duration: One Semester

Total credits:16

Maximum Credits: 16

SEMESTER- XI

MAJOR COURSES

Sr. No.	Course No.	Course Title	Credits	L:T:P	Internal	External	Teachng Hours
1	C-1	Multidisciplinary chemistry	6	5:1:0	40	60	90 hrs
2	C-2	Modern analytical methods	6	5:1:0	40	60	90 hrs
2	C-3	Research methodology	4	3:1:0	40	60	60 hrs

14/05/22

C-1: PAPER- I MULTIDISCIPLINARY CHEMISTRY CREDIT 6

UNIT 1 – GREEN CHEMISTRY AND DESIGNING ORGANIC SYNTHESIS

(a)Basic principles of Green Chemistry, Designing a green synthesis, choice of starting materials, choice of reagents, choice of catalysis, choice of solvents, Green reagents, Green catalyst, Phase transfer catalysis or Green synthesis, Organic synthesis in solid phase, versatile ionic liquids as green solvents, Some examples of synthesis involving basic principles of green chemistry industrial importance.

UNIT 2 – NANOCHEMISTRY

Introduction, classification of nanomaterials, synthesis (Physiochemical and Biological routes), characterization, properties and application of nanomaterials, Carbon based Nano structures and Nano polymers.

UNIT 3- GLOBAL TROPOSPHERIC CHEMISTRY ,CLIMATE CHANGE AND ENVIRONMENT POLLUTION

(a) Radiation balance of the atmosphere and the Greenhouse effect, contribution of trace gases and aerosols to climate change, Recent trends, Ozone, VOC and NO_xcycle in the atmosphere, control strategies and risk assessment, nanoparticles in the atmosphere, their effects on climate change and health.

(b) Aquatic pollution – Inorganic, organic, pesticide, agricultural, industrial and sewage, water quality parameters purification and treatments of waste.

UNIT4- MEDICINAL CHEMISTRY

Development of new drugs, procedures followed in drug design, concepts of lead compound and lead modification, concepts of prodrugs and soft drugs, structureactivity relationship (SAR), factors affecting bioactivity, resonance, inductive effect, isosterism, bio-isosterism, spatial considerations. Quantitative structure activity relationship, Physico-chemical parameters: lipophilicity, partition coefficient, electronic ionization constants, steric, Shelton and surface activity parameters and redox potentials.

UNIT 5– LABORATORY SAFETY TECHNIQUES

(a) **FUNDAMENTAL LABORATORY TECHNIQUES**– Basic principles, basic laboratory Procedures, principles of solution chemistry.
(b) **LABORATORY SAFETY MEASURES**- Handling of radiation, Biohazardous and other toxic experimental materials , chemical spills, leaking compressed gas cylinders , fires, medical emergency accident reporting.

(c) **GENERAL SAFETY** – Health and safety, General safety and operational rules, safety of equipments, Personal protective equipment, and safety practices for disposal of broken glassware.

SUGGESTED BOOKS

1. Principles of Organic Synthesis, M.B. Smith, Academic Press.
2. Environmental Chemistry by Manahan Stanley E, Lewis Publisher.
3. Environmental Chemistry by A.K. De, Wiley Eastern Ltd.
4. Nanochemistry by GlebBoisovich, Sergear Elsevier B.V.
5. OSU Safety Manual 1.01
6. Introduction to Medicinal Chemistry, A. Gringuage, Wiley-VCH
7. Wilson And Gisvold Es Text Rook of Organic Medicinal and Pharmaceutical Chemistry. Ed. Robert F.Dorge.
8. An Introduction to Drug Design, S.S. Pandeya and J.R. Dimmock, New Age International.
9. Burger's Medicinal Chemistry and Drug Discovery, Vol-1(Chapter-9 and Ch-14), Ed. M.E. Wolff, John Wiley.
10. Goodman and Gilman's Pharmacological Basis of Therapeutics, McGraw-Hill.
11. The Organic Chemistry of Drug Design and drug Action, R.B. Silverman, Academic Press.

C-2: PAPER -II MODERN ANALYTICAL METHODS CREDIT 6

Principle, Instrumentation, Applications and latest developments of:

1. Atomic Absorption Spectroscopy
2. Inductively Coupled Plasma Spectroscopy
3. Thermo Gravimetric Analysis
4. Differential Thermal Analysis
5. ^{1}H NMR, ^{13}C NMR, Introduction to COSY and NOESY
6. Electron Spin Resonance (ESR)
7. X-ray diffraction
8. Gas Chromatography – Mass Spectrometry (hyphenated technique)
9. Transmission Electron Microscopy (TEM)
10. Scanning Electron Microscopy (SEM)

SUGGESTED BOOKS

1. Chemical Instrumentation: A systematic approach to Instrumental Analysis by H.A. Stroble. Verlag Addison-Wesley Publishing Co.
2. Treatise on Analytical Chemistry: Vol. I-VII, I.M. Kolthoff, John Wiley & Sons
3. Principles of Instrumental Analysis by D. Skoog and West. New York Holt, Rinehart and Winston
4. Chemical Instrumentation: A systematic Approach by H. A. Strobel, Nueva York, EUA: Wiley .

C-3: PAPER- III RESEARCH METHODOLOGY CREDIT 4

UNIT 1– INTRODUCTION TO RESEARCH METHODOLOGY:

Research methodology, Meaning of research, Scientific thinking, Research fundamentals and terminology, Objectives of research, Types of research, Significance of research, Criteria of good research, Basis of selection of the broad areas of research, selection of research centre, selection of research supervisor, Major research centres in India. Ranking institutions (Criteria and Selection Procedure), Problems encountered by researchers in India.

UNIT 2–DEFINING THE RESEARCH PROBLEMS

(a) What is research problem, selecting the problem, technique involved in defining a problem with illustrations, formulation of hypothesis, Meaning and need for research design, Basic principles of experimental design.

(b) Execution of the research, observation and collection of data, methods of data collection, sampling methods.

UNIT 3–

(a) **LITERATURE SURVEY**- References, Abstraction of a research paper, possible ways of getting oneself abreast of current literature. High rank journals, Impact factors, h – factor, Citation Index.

(b) **SCIENCE AND ETHICS** – Intellectual property and Intellectual property rights, Indian patent system, Research agreement, Ethical theory and applications. Ethical issues in science research and reporting the problem of plagiarism and related issues, International norms and standards.

UNIT 4– INTERPRETATION AND REPORT WRITING:

Meaning of interpretation, Necessity of interpretation, Techniques and precautions in interpretation, Significance of report writing, Research papers and reviews, Different steps in writing report, Layout of the research report, types of reports and articles, Mechanics and precautions of writing research reports, Importance of communication in Science, Developing a research proposal, Different funding agencies of India, Basic knowledge of organizing conferences, symposia, workshop, exhibitions etc.

UNIT 5– COMPUTER FOR CHEMISTS

History of development of computer, brief introduction of computer languages, general awareness of Ms Office, common computer software for chemist and its application

SUGGESTED BOOKS

1. Research Methodology, Methods and Techniques. C.R. Kothari, New Age International (P) Limited Publishers.
2. Research Methodology – Deepak Kumar Bhattacharya Excel Books.
3. The Ethics of Science: An Introduction. David B Resnik, Routledge Publisher, USA.
4. Ethical values for Excellence in Education and Science. J.N. Kapur. VishvaPrakashan, New Delhi.
5. Practical skills in Chemistry, JR Dean, AM Jones, D. Holmes, R. Read, J. Weyers and A. Jones. Pearson Education Ltd. (Prentice Hall).
6. The Student's Guide to Preparing Dissertations and Thesis. London: Kogan.
7. MLA Handbook for writers of research papers, East West Press, New Delhi.
8. Thesis Writing: A manual for Researchers. New Age International Ltd.
9. Write and Publish a scientific paper by Robert A. Day Oryse Press.
10. Research Projects and Research proposals. A guide for Students seeking funding by Paul G. Chaplin. Cambridge University Press.
11. Computer Fundamentals : Concepts, Systems & Applications- 8th Edition by Priti Sinha, Pradeep K., Sinha, bpb publication

NAME OF SUBJECT :	Modern Pharmaceutical Analytical Techniques
SUBJECT CODE :	MPC 101T
BRANCH	Pharmacy
SEMESTER	1st
SESSION	2022-2023
FACULTY NAME	Dr. Gaurav Rajauria

CO STATEMENT: The student will be able to		Level
CO1	Explain general principles and theory of spectroscopy	L1, L2
CO2	Understand the basic instrumentation of HPTLC, HPLC, GC for identification, and characterization of compounds	L2, L3
CO3	Understand the basic concept and instrumentation of Chromatographic techniques	L2, L3
CO4	Learn various separation techniques by employing chromatographic methods	L2, L3
CO5	Understand the basic principles and instrumentation of fluorimeter and atomic absorption spectrometer	L2, L3, L4

Alignment/Mapping of COs & PSOs (Course Articulation Matrix)

(a) CO Mapping with Assessment tools

Course Outcomes	Sessional 1	Sessional 2	End Term Exam
CO MPH 101.1	✓		✓
CO MPH 101.2	✓		✓
CO MPH 101.3	✓	✓	✓
CO MPH 101.4		✓	✓
CO MPH 101.5		✓	✓

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1													2	
2														3
3													3	2
4													2	3
5													3	4
Avg.														

NAME OF SUBJECT :	Advanced Organic Chemistry-I
SUBJECT CODE :	MPC 102T
BRANCH	Pharmacy
SEMESTER	1st
SESSION	2022-2023
FACULTY NAME	Dr. Gaurav Rajauria

CO STATEMENT: The student will be able to		Level
CO1	To describe mechanisms for reactions in organic chemistry, polymer chemistry and biochemistry	L1, L2
CO2	To develop synthetic route for small molecules.	L2, L3
CO3	To apply the structure and theory to the study of organic reaction mechanisms	L2, L3
CO4	To apply all the naming reactions in multistep process in manufacturing of drugs and drug intermediates special reactive intermediates including carbenes, carbanions and free radicals	L2, L3
CO5	To carry out an organic reaction, including isolating, purifying, and characterizing the product.	L2, L3, L4

Alignment/Mapping of COs & PSOs (Course Articulation Matrix)

(a) CO Mapping with Assessment tools

Course Outcomes	Sessional 1	Sessional 2	End Term Exam
CO MPH 102.1	✓		✓
CO MPH 102.2	✓		✓
CO MPH 102.3	✓	✓	✓
CO MPH 102.4		✓	✓
CO MPH 102.5		✓	✓

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1													2	
2														3
3													3	2
4													2	3
5													3	4
Avg.														

NAME OF SUBJECT :	Advanced Medicinal Chemistry
SUBJECT CODE :	MPC 103T
BRANCH	Pharmacy
SEMESTER	1st
SESSION	2022-2023
FACULTY NAME	Dr. Gaurav Rajauria

CO STATEMENT: The student will be able to		Level
CO1	To design around the various marketapproved drug molecules	L1, L2
CO2	To understand the mechanism of action of drugs belonging to the classes of Antihypertensive, Psychoactive.	L2, L3
CO3	Anticonvulsant, H1/H2 receptor antagonistic, COX1 & COX2 inhibiting, Adrenergic & Cholinergic, Antineoplastic and Antiviral agents.	L2, L3
CO4	A detailed understanding of the processes involved in the design, development and discovery of medicinal compounds.	L2, L3
CO5	Will be able .to design and carry out scientific experiments as well as accurately record and analyze the results of such experiments.	L2, L3, L4

Alignment/Mapping of COs & PSOs (Course Articulation Matrix)

(a) CO Mapping with Assessment tools

Course Outcomes	Sessional 1	Sessional 2	End Term Exam
CO MPH 103.1	✓		✓
CO MPH 103.2	✓		✓
CO MPH 103.3	✓	✓	✓
CO MPH 103.4		✓	✓
CO MPH 103.5		✓	✓

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1													2	
2														3
3													3	2
4													2	3
5													3	4
Avg.														

NAME OF SUBJECT :	Chemistry of Natural Products
SUBJECT CODE :	MPC 104T
BRANCH	Pharmacy
SEMESTER	1st
SESSION	2022-2023
FACULTY NAME	Dr. Gaurav Rajauria

CO STATEMENT: The student will be able to		Level
CO1	To attain detailed knowledge about chemistry of medicinal compounds from natural origin.	L1, L2
CO2	To understand general methods of structural elucidation of medicinally active natural compounds.	L2, L3
CO3	To attain knowledge regarding isolation and purification of medicinal compounds from natural origin.	L2, L3
CO4	To characterize products by physical and spectroscopic means including IR, NMR, GC, and MS.	L2, L3
CO5	To know the use of natural products as starting materials.	L2, L3, L4

Alignment/Mapping of COs & PSOs (Course Articulation Matrix)

(a) CO Mapping with Assessment tools

Course Outcomes	Sessional 1	Sessional 2	End Term Exam
CO MPH 104.1	✓		✓
CO MPH 104.2	✓		✓
CO MPH 104.3	✓	✓	✓
CO MPH 104.4		✓	✓
CO MPH 104.5		✓	✓

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1													2	
2														3
3													3	2
4													2	3
5													3	4
Avg.														

NAME OF SUBJECT :	Advanced Spectral Analysis
SUBJECT CODE :	MPC 201T
BRANCH	Pharmacy
SEMESTER	2nd
SESSION	2022-2023
FACULTY NAME	Dr. Gaurav Rajauria

CO STATEMENT: The student will be able to		Level
CO1	Student will learn the various hyphenated analytical instrumental techniques	L1, L2
CO2	Student will deals with different analytical data from different principle instrument.	L2, L3
CO3	The fellow student will gain the interpretation skills	L2, L3
CO4	Student will expose to different analytical data like LC-MS, GC-MS, ATR-IR, DSC etc. theoretically and practically.	L2, L3
CO5	Fellow student will able to handle different analytical data to predict the unknown structures	L2, L3, L4

Alignment/Mapping of COs & PSOs (Course Articulation Matrix)

(a) CO Mapping with Assessment tools

Course Outcomes	Sessional 1	Sessional 2	End Term Exam
CO MPH 201.1	✓		✓
CO MPH 201.2	✓		✓
CO MPH 201.3	✓	✓	✓
CO MPH 201.4		✓	✓
CO MPH 201.5		✓	✓

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1													2	
2														3
3													3	2
4													2	3
5													3	4
Avg.														

NAME OF SUBJECT :	Advanced Organic Chemistry-II
SUBJECT CODE :	MPC 202T
BRANCH	Pharmacy
SEMESTER	2nd
SESSION	2022-2023
FACULTY NAME	Dr. Gaurav Rajauria

CO STATEMENT: The student will be able to		Level
CO1	To utilize green chemistry concepts and to be the effective substitute for conventional chemistry.	L1, L2
CO2	To apply all the catalysis in single & multistep process in manufacturing of drugs and drug intermediates	L2, L3
CO3	To synthesize novel peptidomimetics using peptide chemistry.	L2, L3
CO4	Stereo-chemical features including conformation and stereo electronic effects; reaction dynamics, and photochemical reactions	L2, L3
CO5	To acquire knowledge in the field of sonochemistry.	L2, L3, L4

Alignment/Mapping of COs & PSOs (Course Articulation Matrix)

(a) CO Mapping with Assessment tools

Course Outcomes	Sessional 1	Sessional 2	End Term Exam
CO MPH 202.1	✓		✓
CO MPH 202.2	✓		✓
CO MPH 202.3	✓	✓	✓
CO MPH 202.4		✓	✓
CO MPH 202.5		✓	✓

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1													2	
2														3
3													3	2
4													2	3
5													3	4
Avg.														

NAME OF SUBJECT :	Computer Aided Drug Design
SUBJECT CODE :	MPC 203T
BRANCH	Pharmacy
SEMESTER	2^{nd}
SESSION	2022-2023
FACULTY NAME	Dr. Gaurav Rajauria

CO STATEMENT: The student will be able to		Level
CO1	To utilize various molecular modelling softwares in the design of novel drug-like molecules.	L1, L2
CO2	To apply the various softwares for physicochemical property prediction.	L2, L3
CO3	To understand how current drugs were developed by using pharmacophores modeling and docking technique.	L2, L3
CO4	Understand Working with molecular modeling softwares to design new drug molecules	L2, L3
CO5	Understand the in silico virtual screening protocols	L2, L3, L4

Alignment/Mapping of COs & PSOs (Course Articulation Matrix)

(a) CO Mapping with Assessment tools

Course Outcomes	Sessional 1	Sessional 2	End Term Exam
CO MPH 203.1	✓		✓
CO MPH 203.2	✓		✓
CO MPH 203.3	✓	✓	✓
CO MPH 203.4		✓	✓
CO MPH 203.5		✓	✓

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1													2	
2														3
3													3	2
4													2	3
5													3	4
Avg.														

NAME OF SUBJECT :	Pharmaceutical Process Chemistry
SUBJECT CODE :	MPC 204T
BRANCH	Pharmacy
SEMESTER	2nd
SESSION	2022-2023
FACULTY NAME	Dr. Gaurav Rajauria

CO STATEMENT: The student will be able to		Level
CO1	To develop synthetic routes that is safe, cost-effective, environmentally friendly, and efficient.	L1, L2
CO2	To impart knowledge on the development and optimization of a synthetic route/s.	L2, L3
CO3	The pilot plant procedure for the manufacture of Active Pharmaceutical Ingredients and new chemical entities for the drug development phase.	L2, L3
CO4	To create and carry out work up and separation procedure.	L2, L3
CO5	To predict the outcome of organic reactions using a basic understanding of the general reactivity of functional groups and mechanism.	L2, L3, L4

Alignment/Mapping of COs & PSOs (Course Articulation Matrix)

(a) CO Mapping with Assessment tools

Course Outcomes	Sessional 1	Sessional 2	End Term Exam
CO MPH 204.1	✓		✓
CO MPH 204.2	✓		✓
CO MPH 204.3	✓	✓	✓
CO MPH 204.4		✓	✓
CO MPH 204.5		✓	✓

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1													2	
2														3
3													3	2
4													2	3
5													3	4
Avg.													-	

Programme Outcomes (M. PHARM)

PO1-Applied Pharmacy Knowledge- Possess understanding of the fundamental concepts underlying contemporary pharmaceutical technology, biopharmaceutics, drug regulatory issues, and the development and assessment of innovative drug delivery systems.

PO2- Development and research: Utilise your expertise to create novel medication delivery systems for a variety of pharmaceutical active components. Show that you are familiar with the computer-assisted procedures needed to carry out pharmaceutical research.

PO3-Problem analysis : To recognise, create, and resolve difficulties connected to pharmaceutical development, production, and regulatory processes, enhance your analytical and critical thinking skills.

PO4-Modern tool usage : Utilise current formulation optimisation tools while developing and assessing nanoformulations using statistical hypothesis testing, according to PO4-current Tool Usage. Utilise in silico methods for biopharmaceutical research.

PO5-Communication : Write clear reports, presentations, and documentation. Learn how to communicate effectively.

PO6-Professional identity : Show typical professional behaviour that complies with all legal and regulatory requirements. assist in the education of pharmacy students and the expansion and advancement of the pharmacy profession.

PO7-Leadership skills : In the fields of manufacturing and research, demonstrate your ability to organise tasks according to deadlines and put plans into action. capable of using resources management skills.

PO8-Planning abilities : Develop and use skills for organising and carrying out tasks associated with manufacturing, regulatory filings, and formulation development.

PO9-Pharmaceutical ethics : Show a great degree of justice and honesty. When making judgements, keep ethical standards in mind and accept responsibility for the results.

PO10-Environmental sustainability : Use your talents to enhance production procedures and ensure environmental sustainability while you deal with concerns including environmental contamination, industrial waste, and the excessive use of water.

PO11-Life-long learning : Ability to participate in an independent, ongoing learning process in accordance with the demands of the job and technological improvements. Utilising input from different professions and determining the learning requirements for growth through lifelong learning. Recognise how conferences, seminars, and workshops advance knowledge.

NAME OF SUBJECT :	Modern Pharmaceutical Analytical Techniques
SUBJECT CODE :	(MPH101T)
BRANCH	M.Pharm
SEMESTER	Ist
SESSION	2022 – 2024
FACULTY NAME	

CO STATEMENT: The student will be able to		Level
CO1	Utilise absorption and emission techniques to investigate the pharmaceutical material.	L2
CO2	Investigate the medicinal product using nuclear magnetic spectroscopy methods.	L2
CO3	Apply mass spectroscopy methods to the therapeutic chemical to investigate it.	L2
CO4	Understand the operation, equipment, and uses of various chromatographic procedures.	L2
CO5	Recognise the electrophoresis and X-ray crystallography principles, equipment, and applications.	L3
CO6	Understand the foundations of immunological tests.	L3

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
1														
2														
3														
4														
5														
Avg														

NAME OF SUBJECT :	Drug Delivery Systems
SUBJECT CODE :	(MPH102T)
BRANCH	M.Pharm
SEMESTER	Ist
SESSION	2022 – 2024
FACULTY NAME	

CO STATEMENT: The student will be able to		Level
CO1	Describe the drug delivery methods that provide specific information on how to safely move a pharmaceutical substance in the body to provide the intended therapeutic effect. Additionally, methods, formulations, technologies, and systems for delivering pharmaceutical compounds safely	L3

	to their intended therapeutic effects in the body are discussed.	
CO2	Understand the delivery of vaccines and the various application approaches for clinical usage.	L3
CO3	Ability to communicate the various drug carriers that are used during the drug delivery process in order to increase the safety, effectiveness, and/or selectivity of drug administration.	L2
CO4	Utilise the most recent understanding of drug delivery and consider creating new formulations based on individual needs.	L2
CO5	Recent advances in protein and peptide for parenteral administration methods will provide new dimensions to the delivery of drugs like antibiotics and insulin.	L3

NAME OF SUBJECT :	**MODERN PHARMACEUTICS**
SUBJECT CODE :	**(MPH103T)**
BRANCH	**M.Pharm**
SEMESTER	**Ist**
SESSION	**2022 – 2024**
FACULTY NAME	

CO STATEMENT: The student will be able to		Level
CO1	Utilise preformulation and optimisation approaches while creating new formulations.	L3
CO2	Recognise the significance of technique, tool, and process validation during pharmaceutical manufacture.	L3
CO3	Describe the current standards for industrial management and excellent manufacturing practises	L2
CO4	Examine the value of compaction and compression research for tablets.	L2
CO5	Recognise the many consolidation parameters used in the development and assessment of formulations.	L3

NAME OF SUBJECT :	Regulatory Affairs
SUBJECT CODE :	**(MPH104T)**
BRANCH	**M.Pharm**
SEMESTER	**Ist**
SESSION	**2022 – 2024**
FACULTY NAME	

CO STATEMENT: The student will be able to	Level

CO1	Learn about innovator and generic drug concepts, the drug development process, regulatory advice, and the requirements for the application and approval processes.	L3
CO2	Understand how to create dossiers and submit them to regulatory agencies in various nations.	L3
CO3	Understanding of the post-approval regulatory requirements for active ingredients and pharmaceutical products, including the filing of global documents in CTD/eCTD formats.	L2
CO4	Become familiar with the regulatory guidance and guidelines for the application and approval processes in various countries.	L2
CO5	Recognise the pharmacovigilance, clinical trial monitoring procedures, and requirements for obtaining approvals to conduct clinical studies.	L3

NAME OF SUBJECT :	**MOLECULAR PHARMACEUTICS (NANOTECHNOLOGY & TARGETED DDS)**
SUBJECT CODE :	(MPH201T)
BRANCH	**M.Pharm**
SEMESTER	2^{nd}
SESSION	**2022 – 2024**
FACULTY NAME	

CO STATEMENT: The student will be able to		
		Level
CO1	Know the fundamental components and methods of targeted medication delivery systems.	L3
CO2	Describe the procedures for producing and testing polymeric nanoparticles and liposomes.	L3
CO3	Describe the creation processes and functions of vesicular nanocarriers and monoclonal antibodies.	L2
CO4	Talk about the various facets of pulmonary medication delivery systems.	L2
CO5	Selecting the elements for medicinal delivery systems based on nucleic acids.	L3

NAME OF SUBJECT :	**ADVANCED BIOPHARMACEUTICS AND PHARMACOKINETICS**
SUBJECT CODE :	(MPH202T)
BRANCH	**M.Pharm**
SEMESTER	2^{nd}
SESSION	**2022 – 2024**
FACULTY NAME	

CO STATEMENT: The student will be able to		Level
CO1	Recognise fundamental pharmacokinetic and biopharmaceutical concepts.	L3
CO2	Using pharmacokinetic and biopharmaceutical criteria, describe how dosing regimens for the medications were designed and evaluated.	L3
CO3	Determine the pharmacokinetic models and parameters by analysing the raw data. the most effective way to describe how drugs are absorbed, distributed, metabolised, and eliminated	L2
CO4	Understand how to critically evaluate biopharmaceutics research on drug product equivalence.	L2
CO5	Apply fundamental pharmacokinetic principles to probable clinical pharmacokinetic issues in order to resolve them.	L3

NAME OF SUBJECT :	COMPUTER AIDED DRUG DELIVERY SYSTEM
SUBJECT CODE :	(MPH203T)
BRANCH	**M.Pharm**
SEMESTER	2nd
SESSION	**2022 – 2024**
FACULTY NAME	

CO STATEMENT: The student will be able to		Level
CO1	Describe the roles of statistical modelling and quality by design in the creation of pharmaceuticals.	L3
CO2	Talk about the drug disposition descriptors used in computational modelling.	L3
CO3	Recognise the morals and legal safeguards surrounding computing in pharmaceutical research.	L2
CO4	In silico methods for biopharmaceutical characterisation should be defended.	L2
CO5	Recognise the significance of automation in the development of pharmaceuticals	L3

NAME OF SUBJECT :	COSMETIC AND COMECEUTICALS
SUBJECT CODE :	(MPH204T)
BRANCH	**M.Pharm**
SEMESTER	2nd
SESSION	**2022 – 2024**

FACULTY NAME	

CO STATEMENT: The student will be able to		Level
CO1	Learn about the important cosmeceutical and cosmetic ingredients.	L3
CO2	Recognise the fundamental components of cosmetics for a variety of compositions.	L3
CO3	Know the current technologies in the market	L2
CO4	Knowing scientific concepts will help you create cosmetics and cosmeceuticals with the desired level of safety.	L2
CO5	Recognise the regulatory elements that affect cosmetics	L3

NAME OF SUBJECT :	**PHARMACEUTICAL BIOTECHNOLOGY**
SUBJECT CODE :	**(BP605T)**
COURSE/ BRANCH	B. Pharmacy
SEMESTER	VIth
SESSION	2022-23
FACULTY NAME	Mrs Pratibha Mishra

CO STATEMENT : The student will be able to		Level
CO1	Acquiring a fundamental knowledge of biotechnology disciplines like genetic engineering, protein engineering, enzyme production, enzyme immobilization, and biosensor technology. Learning the principles and techniques involved in the development of biopharmaceuticals, such as monoclonal antibodies and recombinant proteins, for therapeutic purposes.	L3
CO2	Understanding genetic engineering, research into recombinant DNA technology, PCR, and the production of biotechnological products. Students should be aware about the application of biotechnology in the development of new drugs, vaccines, and diagnostic tools for the benefits of human health and quality of life.	L3
CO3	Understanding of the immune system, hypersensitivity reactions, monoclonal antibodies, and vaccines. Students should Gain knowledge about the development of monoclonal antibodies for the treatment of cancer and autoimmune diseases. Additionally, development of vaccines to prevent infectious diseases.	L2
CO4	Understanding of the importance of various immunological techniques, i.e. microbial genetics, microbial biotransformation, and mutation and their contribution in the development of various biotechnology-based solutions for preventing and treating diseases.	L2
CO5	Learning about fermentation technology and understanding its crucial importance in the production of various pharmaceutical products, such as antibiotics and vaccines, as well as the collection, processing and storage of Blood Products.	L3

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
1														
2														
3														
4														
5														
Avg														

PHARMACEUTICAL BIOTECHNOLOGY (BP605T)

- **CO1:** Understanding the basics of biotechnology including genetic engineering, Protein Engineering and Production of Enzymes, enzymes immobilization and biosensors.

CO1: Acquiring a foundational knowledge of biotechnology disciplines like genetic engineering, protein engineering, enzyme production, enzyme immobilization, and biosensor technology. Learning the principles and techniques involved in the development of biopharmaceuticals, such as monoclonal antibodies and recombinant proteins, for therapeutic purposes.

- **CO2:** Understanding Genetic engineering, Study of Recombinant DNA technology, PCR and production of biotechnological products.

CO2: Understanding genetic engineering, research into recombinant DNA technology, PCR, and the production of biotechnological products. Application of biotechnology in the development of new drugs, vaccines, and diagnostic tools for the benefits of human health and quality of life.

- **CO3:** Understanding the immune system, Hypersensitivity reactions, Monoclonal antibodies and vaccines.

***CO3:** Understanding the immune system, hypersensitivity reactions, monoclonal antibodies, and vaccines. Gaining knowledge about the development of monoclonal antibodies for the treatment of cancer and autoimmune diseases. Additionally, development of vaccines to prevent infectious diseases.*

- **CO4:** Know the importance of various immunological techniques i.e. Microbial genetics, Microbial biotransformation and Mutation.

***CO4:** Understanding the importance of various immunological techniques, i.e. microbial genetics, microbial* *biotransformation, and mutation. and their contribution in the development of various biotechnology-based solutions for preventing and treating diseases.*

- **CO5:** Study of fermentation technology, production of various pharmaceutical products and Collection, Processing and Storage of Blood Products.

CO5:Learning about *fermentation technology and understanding its crucial importance in the production of various pharmaceutical products, such as antibiotics and vaccines, as well as the collection, processing and storage of Blood Products.*

INSTITUTE OF PHARMACY AND PARAMEDICAL SCIENCES
DR BHIMRAO AMBEDKAR UNIVERSITY, AGRA

B.PHARM PROGRAMME OUTCOME

B.PHARM Programme Outcomes	After completion graduate are ready to learn and acquire
PO1	**Pharmacy Expertise:** Possess an understanding of the fundamental concepts and knowledge needed to practise pharmacy, including biological and pharmaceutical sciences, behavioral and social sciences, administrative pharmacy, and manufacturing practices.
PO2	**Planning Skills:** Acquire strong planning skills, particularly those for managing time, resources, delegating, and organization. Create and carry out plans, and schedule tasks to meet deadlines.
PO3	**Issue identification:** will become able to apply scientific inquiry principles to problem-solving and decision-making in daily practise by thinking critically, analytically, and clearly. Make rational decisions by doing systematic information gathering, analysis, evaluation, and application.
PO4	**Use of Modern Techniques in Pharmaceutical sciences:** Learn to choose, and use suitable techniques, resources, and computing technologies for modern pharmacy while being aware of their limitations.
PO5	**Leadership aptitudes:** Acquire leadership aptitudes, refer to the specific skills, qualities, and abilities that are valued and necessary for individuals in leadership roles within the pharmaceutical industry.
PO6	**Professional identity**: Able to develop Professional identity in pharmacy including education, training, experience, and the values upheld by the pharmacy profession, knowledgeable about medications, their effects, and their safe and appropriate use, able to play crucial role in ensuring patient safety, promoting public health, and optimizing medication therapy outcomes.
PO7	**Pharmaceutical Practice**: Graduates will be capable of applying their knowledge to provide pharmaceutical care to patients & able to accurately dispense medications, evaluate prescriptions for appropriateness, and counsel patients on the safe and effective use of medications.
PO8	**Communication Skills:** Possess strong communication skills, both written and verbal and be able to effectively communicate with patients, healthcare professionals, and other stakeholders, using appropriate terminology and conveying complex information in a clear and understandable manner.
PO9	**Professionalism and Ethical Conduct**: Able to uphold patient confidentiality, and embrace the ethics and ideals of the pharmacy profession. Students will be able to act with integrity, professionalism, and professionalism. Participate in professional development and lifelong learning to stay abreast of changes in the pharmaceutical industry.

Bachelor of Pharmacy

YEAR /Sem.	SUBJECT CODE& SUBJECT	Course outcomes (COs):
I sem.	BP101T. HUMANANATOMY AND PHYSIOLOGY-I	**CO1:** 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.
	BP102T. PHARMACEUTICAL ANALYSIS	**CO2:** This course deals with the fundamentals of analytical chemistry and principles of electrochemical analysis of drugs.
	BP103T. PHARMACEUTICS- I	**CO3:** This course is designed to impart a fundamental knowledge on the preparatory pharmacy with arts and science of preparing the different conventional dosage forms.
	BP104T.PHARMACEUTICAL INORGANIC CHEMISTRY	**CO4:** This subject deals with the monographs of inorganic drugs and pharmaceuticals.
	BP105T. COMMUNICATION SKILLS	**CO5:** 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 withthe team as a team player and will add value to the pharmaceutical business.
	BP 106RBT.REMEDIAL BIOLOGY	**CO6:** To learn and understand the components of living world, structure andfunctional system of plant and animal kingdom.
	BP 106RMT. REMEDIAL MATHEMATICS	**CO7:** 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.
II sem.	BP 201T. HUMAN ANATOMY AND PHYSIOLOGY-II	**CO8:** This subject is designed to impart fundamental knowledge on the structureand 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
	BP202T. PHARMACEUTICAL ORGANIC CHEMISTRY -I	**CO9:** 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.
	BP203 T. BIOCHEMISTRY	**CO10:** 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.

	BP 204T. PATHOPHYSIOLOGY	**CO11:** 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
	BP205 T. COMPUTER APPLICATIONS IN PHARMACY	**CO12:** This subject deals with the introduction Database, Database Management system, computer application in clinical studies and use of databases.
	BP 206 T. ENVIRONMENTAL SCIENCES	**CO13:** 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.
III Sem.	BP301T. PHARMACEUTICA L ORGANIC CHEMISTRY –II	**CO14:** 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.
	BP302T. PHYSICAL PHARMACEUTICS-I	**CO15:** 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.
	BP 303 T. PHARMACEUTICAL MICROBIOLOGY	**CO16:** Study of all categories of microorganism especially for the production of alcohol antibiotics, vaccines, vitamins enzymes etc.
	BP 304 T. PHARMACEUTICA L ENGINEERING	**CO17:** This course is designed to impart a fundamental knowledge on the art and science of various unit operations used in pharmaceutical industry.
IV sem.	BP401T. PHARMACEUTICA L ORGANIC CHEMISTRY –III	**CO18:** 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.
	BP402T. MEDICINAL CHEMISTRY – I	**CO19:** 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.
	BP 403 T. PHYSICAL PHARMACEUTICS- II	**CO20:** The course deals with the various physical 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.
	BP 404 T. PHARMACOLOGY-I	**CO21:** 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.

	BP 405 T. PHARMACOGNOSY AND PHYTOCHEMISTRY I	**CO22:** 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.
V sem.	**BP501T. MEDICINAL CHEMISTRY – II**	**CO23:** 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.
	BP 502 T. INDUSTRIAL PHARMACY-I	**CO24:** 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
	BP503.T. PHARMACOLOGY-II	**CO25:** 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.
	BP504 T. PHARMACOGNOSY AND PHYTOCHEMISTRY II	**CO26:** 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.
	BP 505 T. PHARMACEUTICAL JURISPRUDENCE	**CO27:** This course is designed to impart basic knowledge on important legislations related to the profession of pharmacy in India.
VI sem.	**BP601T. MEDICINAL CHEMISTRY – III**	**CO28:** 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.
	BP602 T. PHARMACOLOGY-III	**CO29:** 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.
	BP 603 T. HERBAL DRUG TECHNOLOGY	**CO30:** 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.
	BP 604 T. BIOPHARMACEUTICS AND PHARMACOKINETICS	**CO31:** This subject is designed to impart knowledge and skills of Biopharmaceutics and pharmacokinetics and their applications in pharmaceuticaldevelopment, design of dose and dosage regimen and in solving the problems arised therein.

	BP 605 T. PHARMACEUTICA L BIOTECHNOLOGY	**CO32:** 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.
	BP606T. PHARMACEUTICA L QUALITY ASSURANCE	**CO33:** 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.
VII sem.	**BP701T. INSTRUMENTAL METHODS OF ANALYSIS**	**CO34:** 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
	BP 702 T. INDUSTRIAL PHARMACYII	**CO35:** This course is designed to impart fundamental knowledge on pharmaceutical product development and translation from laboratory to market.
	BP 703T. PHARMACY PRACTICE	**CO36:** 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 counseling for improved patient care in the community set up.
	BP 704T. NOVEL DRUG DELIVERY SYSTEMS	**CO37:** This subject is designed to impart basic knowledge on the area of novel drug delivery systems.
VIII sem.	**BP801T. BIOSTATISITCS AND RESEARCH METHODOLOGY**	**CO38:** 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.
	BP 802T. SOCIAL AND PREVENTIVE PHARMACY	**CO39:** 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.
	BP803ET. PHARMA MARKETING MANAGEMENT	**CO40:** 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.
	BP804 ET: PHARMACEUTICA L REGULATORY SCIENCE	**CO41:** 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.

	BP 805T. PHARMACOVIGILA NCE	**CO42:** 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.
	BP 806 ET. QUALITY CONTROL AND STANDARDIZATIO N OF HERBALS	**CO43:** 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.
	BP 807 ET. COMPUTER AIDEDDRUG DESIGN	**CO44:** This subject is designed to provide detailed knowledge of rational drug design process and various techniques used in rational drug design process.
	BP808ET. CELL AND MOLECULAR BIOLOGY	**CO45:** 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 organisms such as humans, plants, and sponges.
	BP808ET. CELL AND MOLECULAR BIOLOGY	**CO45:** 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 organisms such as humans, plants, and sponges.
	BP809ET. COSMETIC SCIENCE	**CO46:** This subject deals with the study of cosmetics including their preparation, uses and effects. This course is designed to impart knowledge and skills necessary forth fundamental need for cosmetic and cosmeceutical products.
	BP810 ET. PHARMACOLOGICAL SCREENING METH ODS	**CO47:** This subject is designed to impart the basic knowledge of preclinical studies in experimental animals including design, conduct and interpretations of results.
	BP 811 ET. ADVANCED INSTRUMENTATION TECHNIQUES	**CO48:** 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 andpractical knowledge on modern analytical instruments that are used for drug testing.
	BP 812 ET. DIETARY SUPPLEMENTS AND NUTRACEUTICALS	**CO49:** This subject covers foundational topic that are important for understanding the need and requirements of dietary supplements among differentgroups in the population.

M. Pharm (pharmaceutics)

PHARMACEUTICS	After completion graduate are ready to learn and acquire
PO1	Imparting theoretical knowledge and practical skills with the use of various advanced analytical instruments including NMR, Mass spectrometer, IR, HPLC, GC etc. It shall be applicable for identification, characterization, qualitative and quantitative analysis of various drugs in single and combination dosage forms.
PO2	In depth knowledge in the area of advances in novel drug delivery systems. This shall enable students to know the approaches for development of novel drug delivery systems, criteria for selection of drugs and polymers for the development of delivering system and about the formulation and evaluation of Novel drug delivery systems.
PO3	Imparting knowledge on various aspects viz. manufacturing of bulk, formulations in pharmaceutical industries. To understand the system as whole component wise studies is dispensed i.e., about preformulation studies, Active Pharmaceutical Ingredients, Generic drug Product development, Industrial Management, GMP Considerations, Optimization Techniques, Pilot Plant Scale Up Techniques, Stability Testing, sterilization process and packaging of dosage forms.
PO4	The information on regulatory affairs serves to gain advanced knowledge and skillsrequired 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 : filingprocess of IND, NDA and ANDA.
PO5	The knowledge of Biopharmaceutics & Pharmacokinetics is for development of 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.
PO6	Necessary training is imparted on computer applications in pharmaceutical research and development, it helps 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.
PO7	Appreciable knowledge and exercise is imparted on Biostatisitcs And Research Methodology to make the students understand the applications like descriptive statistics, Graphics, Correlation, Regression, logistic regression Probability theory, Sampling technique, Parametric tests, Non Parametric tests, ANOVA of Biostatics in Pharmacy.

M. Pharm (Pharmaceutics)

Course outcomes (COs):

YEAR/ Sem.	SUBJECT & SUBJECT CODE	OUTCOME
I sem.	MODERN PHARMACEUTICAL ANALYTICAL TECHNIQUES(MPH101T)	**CO1:** This subject deals with various advanced analytical instrumental techniques for identification, characterization and quantification of Active Pharmaceutical Ingredient
	DRUG DELIVERY SYSTEMS (MPH 102T)	**CO2:** This course is designed to impart knowledge on the area of Drug delivery at onsite of action
	MODERN PHARMACEUTICS (MPH 103T)	**CO3:** Course designed to impart advanced knowledge and skills
	REGULATORY AFFAIRS(MPH 104T)	**CO4:** Course designed to impart advanced knowledge and skills clinical trials and submitting regulatory documents : filing process of IND, NDA and ANDA
II sem.	MOLECULAR PHARMACEUTICS(NTDS) (MPH 201T)	**CO5:** This course is designed to impart knowledge on the area of advances in novel drug delivery systems
	ADVANCED BIOPHARMACEUTICS	**CO6:** 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
	COMPUTER AIDED DRUG DEVELOPMENT	**CO7:** 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.
	COSMETICS AND COSMECEUTICALS(MPH 204T)	**CO8:** This course is designed to impart knowledge and skills necessary forth fundamental need for cosmetic and cosmoceutical products
III sem.	RESEARCH METHODOLOGY & BIOSTATISTICS (MRM	**CO9:** The student will be known the Biostatistics arrangement, presentation and formation of tables and charts. They also know the correlation and regression & application of different methods, analysis of data and also learn how to write dissertation, thesis and Research paper.

Program Specific Outcomes (PSOs)

PSO1: To develop new/ groundbreaking medications / bulk drug/pharmaceutical formulation require latest methods, technologies and processes. In this, phase/topic wise is covered in the syllabus e.g., selection of drugs, dose calculations, dose adjustments by applying biopharmaceutics theories, pharmacokinetic and bioequivalence models, *in-vitro* and *in-vivo* studies using computer simulations, population modeling's, potential clinical pharmacokinetic and problem analysis, selection of polymers and various preformulation elements, pilot plant scale up techniques, industrial management, GMP considerations, stability testing, sterilization, formulation, evaluation and packaging of dosage forms.

PSO2: Professional Training to the students to work on drug compounds and develop new medications based on research. In this students learn test medications for efficiency and safety, oversee the production process to ensure medication are produced accurately, conducting clinical drug trials and evaluating the results of these trials to gauge a drug's effectiveness and to determine potential risks or side effects.

PSO3: Students are trained to collaborate with various pharmaceutical companies and variety of health care professionals to ensure clinical drug trials are conducted safely as per regulatory guidelines for the testing of drugs.

PSO4: To develop a scientific innovation thought /innovation by assigning independent research projects to each students under specialized subjects supervisors. The findings/outcome of the research are promoted to be published in reputed national/international journals.

B. PHARM (PROGRAMME OUTCOME)

- **PO1-Pharmacy Knowledge :** Possess an understanding of the fundamental concepts and knowledge needed to practise pharmacy, including biological and pharmaceutical sciences, as well as behavioural, social, and administrative pharmacy fields and manufacturing techniques.
- **PO2-Planning Abilities :** Possess strong planning skills, particularly those for managing time, resources, delegating, and organisation. Create and carry out plans, and schedule tasks to meet deadlines.
- **PO3-Problem analysis :** Apply scientific inquiry principles to problem-solving and decision-making in daily practise by thinking critically, analytically, and clearly. Make rational decisions by doing systematic information gathering, analysis, evaluation, and application.
- **PO4-Modern tool usage :** Learn, select, and apply appropriate methods and procedures, resources, and modern pharmacy-related computing tools with an understanding of the limitations.
- **PO5-Leadership skills :** When preparing adjustments necessary to achieve ethical, professional, and social obligations, understand how people react to change, motivational factors, leadership, and team-building. Assume leadership responsibilities or 'active citizenship duties when necessary to promote improvements in health and wellbeing.
- **PO6-Professional Identity :** Understand, analyze and communicate the value of their professional roles in society (e.g. health care professionals, promoters of health, educators, managers, employers, employees).
- **PO7-Pharmaceutical Ethics :** Respect one's moral ideals and use them in social and professional settings. Show behaviour that acknowledges cultural and individual differences in values, communication, and lifestyles. Apply ethical principles while making judgements, use ethical frameworks when doing so, and accept responsibility for the results of your choices.
- **PO8-Communication :** Well communicate with the pharmacy community and the general public, including the ability to understand and produce effective reports, present and document well, and give and receive clear directions.
- **PO9-The Pharmacist and society :** Assess societal, health, safety, and legal issues, as well as the resulting obligations pertinent to the professional practise of pharmacy, using reasoning supported by contextual knowledge.
- **PO10-Environment and sustainability :** Understanding the effects of professional pharmacy solutions in societal and environmental contexts, as well as demonstrating awareness of and the need for sustainable development, are part of PO10—Environment and sustainability.
- **PO11-Life-long learning :** Understand the importance of, and be prepared for, autonomous lifelong learning in the broadest sense of technological development. Use self-evaluation and other people's feedback to your advantage to pinpoint your own learning needs and continuously meet them.

B. PHARM (ALL PHARMACEUTICS SUBJECT)
CO (COURSE OUTCOME)

NAME OF SUBJECT:	**PHARMACEUTICS I**	
SUBJECT CODE :	**(BP103T)**	
BRANCH	**B.Pharm**	
SEMESTER	**Ist**	
SESSION	**2022-2023**	
FACULTY NAME	**Dr. Bhoomika Chaudhary**	
CO STATEMENT: The student will be able to		Level
CO1	Students will be able to learn about pharmacy careers, pharmacopoeias, and the history of the pharmacy profession in India after completing this course.	L3
CO2	Learn about the various dosage forms, prescriptions, and their component parts, as well as how to calculate a dose based on the patient's age, weight, and body surface area.	L3
CO3	Students will be able to comprehend pharmaceutical calculations, their many systems, and techniques of computation after completing this course.	L2
CO4	Describe liquid and powder dosage forms, excipients employed in their creation, and methods used to increase solubility.	L2
CO5	After completing this course, students will be able to describe the various monophasic liquid formulation types and how they are made.	L3
CO6	Describe the biphasic liquid formulations, the stability issues that come with them, and the solutions to these issues.	L3
CO7	Students will get knowledge about suppository preparation techniques, displacement value, and computations after completing this course.	L3
CO8	Give examples of pharmacological incompatibilities of each kind.	L3
CO9	Students will be able to describe semisolid dosage forms, methods and factors influencing drug skin penetration, manufacture of various types of semisolid dosage forms, and evaluation of such forms after completing this course.	L3

NAME OF SUBJECT :	**PHYSICAL PHARMACEUTICS I**	
SUBJECT CODE :	**(BP302T)**	
BRANCH	**B.Pharm**	
SEMESTER	**3rd**	
SESSION	**2022-2023**	
FACULTY NAME	**Dr. Bhoomika Chaudhary**	
CO STATEMENT: The student will be able to		Level
CO1	Students will be able to comprehend the mechanics of solute-solvent interactions, various factors that increase the solubility of pharmaceuticals, and diffusion principles in biological systems after completing this course.	L3
CO2	Learn about the many types of liquids, Raoult's law, the distribution law, the solubility of gas in liquids, and the solubility of liquid in liquids.	L3
CO3	Students will be able to comprehend eutectic mixtures, various solid forms, and the states and properties of matter after completing this course.	L2
CO4	In creating the dosage forms, describe the various physicochemical features of the medicinal compounds.	L2
CO5	After completing this course, students will be able to define surface tension, distinguish it from interfacial tension, and understand several techniques for measuring both tensions.	L3
CO6	Describe HLB Scale, surface active agents, and adsorption at solid-liquid interfaces.	L3
CO7	Students will be able to understand complexation, various types of complexation, and their techniques of analysis after completing this course.	L3
CO8	Describe protein binding and how it affects the way drugs work and complex crystal structures.	L3
CO9	Students who successfully complete this course will be able to explain the pH scale proposed by Sorensen, its methods of determination, buffer isotonic solutions, the rationale for preserving the isotonicity of medication solutions, and buffers in pharmaceutical and biological systems.	L3

NAME OF SUBJECT :	**PHARMACEUTICAL ENGINEERING**	
SUBJECT CODE :	**(BP304T)**	
BRANCH	**B.Pharm**	
SEMESTER	**3rd**	
SESSION	**2022-2023**	
FACULTY NAME	**Dr. Bhoomika Chaudhary**	
CO STATEMENT: The student will be able to		Level
CO1	Recognize the importance of size reduction, size separation and fluid flow during pharmaceutical manufacturing.	L3
CO2	Schematize and apply the principles of different heat processes used in pharmaceutical industries.	L3
CO3	Describe the mechanisms and applications of drying and mixing processes.	L2
CO4	Solve the issues related to filtration and centrifugation.	L2
CO5	Apply different preventive methods used for the control of corrosion in pharmaceutical plants.	L3

NAME OF SUBJECT :	**PHYSICAL PHARMACEUTICS-II**	
SUBJECT CODE :	**(BP-403T)**	
BRANCH	**B.Pharm**	
SEMESTER	**4th**	
SESSION	**2022-2023**	
FACULTY NAME	**Dr. Bhoomika Chaudhary**	
CO STATEMENT: The student will be able to		Level
CO1	To create a dosage form, one must be aware of the many physicochemical features of drug molecules.	L3
CO2	Recognise how viscosity and flow behaviour relate to the development of formulations and the assessment of dose forms.	L3
CO3	Understanding of physicochemical characteristics, formulation elements, and instability markers in the development of biphasic liquid dosage forms.	L2
CO4	Explain how to incorporate particle size variables into the creation of dosage forms.	L2

NAME OF SUBJECT :	**INDUSTRIAL PHARMACY-I**	
SUBJECT CODE :	**(BP502T)**	
BRANCH	**B.Pharm**	
SEMESTER	**5th**	
SESSION	**2022-2023**	
FACULTY NAME	**Dr. Bhoomika Chaudhary**	
CO5	Understanding chemical kinetic principles and applying them to formula expiration dates	L3
CO STATEMENT: The student will be able to		Level
CO1	Learn about pre-formulation analysis	L3
CO2	Students should be able to explain the manufacturing process for tablets, syrups, suspensions, and emulsions.	L3
CO3	Learn about the numerous factors that go into the creation of capsules and pellets.	L2
CO4	Recognise the production processes for the dosage forms ophthalmic and prenteral.	L2
CO5	Competent to develop cosmetic products and comprehend packaging for pharmaceuticals.	L3

NAME OF SUBJECT:	**PHARMACEUTICAL JURISPRUDENCE**	
SUBJECT CODE :	**(BP505T)**	
BRANCH	**B.Pharm**	
SEMESTER	**5th**	
SESSION	**2022-2023**	
FACULTY NAME	**Dr. Bhoomika Chaudhary**	
CO STATEMENT: The student will be able to		Level
CO1	The regulations governing medicines and how they affect the creation and promotion of drugs.	L3
CO2	Various pharmaceutical laws and acts in India.	L3
CO3	The organisations and bodies that oversee the production and distribution of medications.	L2
CO4	The code of ethics for the practise of pharmacy.	L2
CO5	Different Intellectual Property Rights.	L3
CO6	An assortment of offences and punishments for breaking certain Acts.	L2

NAME OF SUBJECT:	**BIOPHARMACEUTICS & PHARMACOKINETICS**	
SUBJECT CODE :	**(BP604T)**	
BRANCH	**B.Pharm**	
SEMESTER	**6^{th}**	
SESSION	**2022-2023**	
FACULTY NAME	**Dr. Bhoomika Chaudhary**	
CO STATEMENT: The student will be able to		Level
CO1	After completion of this course students will able to understand the mechanisms of drug absorption through GIT, factors influencing drug absorption though GIT and absorption of drug from non per oral extra-vascular routes.	L3
CO2	Know about the tissue permeability of drugs, kinetics of protein binding and clinical significance of protein binding of drugs.	L3
CO3	After completion of this course students will able to understand the basic understanding of metabolic pathways, factors affecting renal excretion of drugs and non renal routes of drug excretion of drugs.	L2
CO4	Know about the absolute and relative bioavailability, in-vitro drug dissolution models, in-vitro-in-vivo correlations, bioequivalence studies and methods to enhance the dissolution rates and bioavailability of poorly soluble drugs.	L2
CO5	After completion of this course students will able to explain compartmental modeling, various pharmacokinetic parameters, their significance and applications.	L3
CO6	After completion of this course students will able to know about kinetics of multiple dosing, calculations of loading and mainetnance doses and their significance.	L2
CO7	After completion of this course students will able to understand the concept of non-linear pharmacokinetics and factors causing non-linearity and Michaelis-menton method of estimating parameters.	L3

NAME OF SUBJECT:	**INDUSTRIAL PHARMAÇY-I**	
SUBJECT CODE :	**(BP606T)**	
BRANCH	**B.Pharm**	
SEMESTER	**6th**	
SESSION	**2022-2023**	
FACULTY NAME	**Dr. Bhoomika Chaudhary**	
CO STATEMENT: The student will be able to		Level
CO1	Understand the fundamental ideas behind GMP, cGMP, and GLP in the pharmaceutical sector.	L3
CO2	Educate yourself with ICH guidelines and stability testing guidelines.	L3
CO3	Describe the value of documentation.	L2
CO4	Determine the duties of the QA and QC departments.	L2
CO5	Learn about secondary packaging materials, rubber closures, and quality control testing for containers.	L3

NAME OF SUBJECT:	**INDUSTRIAL PHARMACY-II**	
SUBJECT CODE :	**(BP702T)**	
BRANCH	**B.Pharm**	
SEMESTER	**7th**	
SESSION	**2022-2023**	
FACULTY NAME	**Dr. Bhoomika Chaudhary**	
CO STATEMENT: The student will be able to		Level
CO1	Learn how to scale up pharmaceutical dosage forms and the pilot plant procedure.	L3
CO2	Interpreting and explaining the technology transfer process from lab scale to commercial batch.	L3
CO3	Learn about the various laws and ordinances that govern the pharmaceutical sector.	L2
CO4	Recognise the regulatory guidelines and procedures for drug product approval.	L2
CO5	Equipped to comprehend the Indian regulatory structure and the quality management system.	L3

NAME OF SUBJECT:	**PHARMACY PRACTICE**	
SUBJECT CODE :	**(BP703T)**	
BRANCH	**B.Pharm**	
SEMESTER	7^{th}	
SESSION	**2022-2023**	
FACULTY NAME	**Dr. Bhoomika Chaudhary**	
CO STATEMENT: The student will be able to		Level
CO1	Know and understand the Hospital organization and detect and assess adverse drug reactions, reporting and its management.	L3
CO2	Knowledge of various drug distribution methods system in the hospital, and monitor drug therapy of Patient, role pharmacist in medication adherence and community pharmacy management .also know how to obtain medication history interview	L3
CO3	Know and understand guideline of know pharmaceutical care services such therapeutic committee, drug information services, patient counseling, and also able to answer the role of pharmacist in education and training of program., monitor drug therapy of patient through medication chart review and clinical review.	L2
CO4	Able to understand the medication of management, budget preparation and its implementation, and also help in rational use of common over the counter medication	L2
CO5	Able to understand the appreciate pharmacy stores and inventory control management and able to interpret selected laboratory results of specific disease states and controlling of investigational use of drugs.	L3

NAME OF SUBJECT:	NOVEL DRUG DELIVERY SYSTEMS	
SUBJECT CODE :	(BP704T)	
BRANCH	B.Pharm	
SEMESTER	7^{th}	
SESSION	2022-2023	
FACULTY NAME	Dr. Bhoomika Chaudhary	
CO STATEMENT: The student will be able to		Level
CO1	Know the criteria for selection of drugs and polymers for the development of novel drug delivery systems and understand various approaches for development of novel drug delivery systems, their formulation and evaluation.	L3
CO2	Know the approaches, technologies and drug carriers used in the process of drugdelivery which serves to improve the selectivity, effectiveness, and/or safety of drug administration.	L3
CO3	The students should understand about Transdermal Drug Delivery Systems, Gastro-retentive drug delivery systems and Naso-pulmonary drug delivery system.	L2
CO4	To understand Targeted Drug Delivery including liposomes, niosomes, nanoparticles, monoclonal antibodies.	L2
CO5	To understand Ocular Drug Delivery Systems and Intrauterine Drug Delivery Systems including intra uterine devices (IUDs).	L3

NAME OF SUBJECT:	SOCIAL AND PREVENTIVE PHARMACY	
SUBJECT CODE :	(BP802T)	
BRANCH	B.Pharm	
SEMESTER	8th	
SESSION	2022-2023	
FACULTY NAME	Dr. Bhoomika Chaudhary	Level
CO STATEMENT: The student will be able to		
CO1	Able to learn about health issues, diseases, and health education, as well as obtain understanding about diet and hygiene.	L3
CO2	Learn about the prevention and treatment of many diseases.	L3
CO3	Possess knowledge of numerous national health programmes.	L2
CO4	Awareness of the national health intervention programme.	L2
CO5	Understand about NRHM and NUHM, as well as community services.	L3

NAME OF SUBJECT:	PHARMACEUTICAL MARKETING MANAGEMENT	
SUBJECT CODE :	BP803ET	
BRANCH	B.Pharm	
SEMESTER	8th	
SESSION	2022-2023	
FACULTY NAME	Dr. Bhoomika Chaudhary	Level
CO STATEMENT: The student will be able to		
CO1	Students are able to study about pharmaceutical marketing.	L3
CO2	Students who learn about product positioning in pharmaceutical marketing may comprehend how to promote pharmaceutical products in a cutthroat industry.	L3
CO3	The goal of the course is to give students a basic understanding of pharmaceutical marketing channels.	L2
CO4	The personnel are prepared to take on tough roles in sales and product management by the knowledge and expertise of marketing management.	L2
CO5	Students are able to study about pharmaceutical marketing.	L3

NAME OF SUBJECT:	**PHARMACEUTICAL REGULATORY SCIENCE**	
SUBJECT CODE :	**BP804ET**	
BRANCH	**B.Pharm**	
SEMESTER	**8^{th}**	
SESSION	**2022-2023**	
FACULTY NAME	**Dr. Bhoomika Chaudhary**	**Level**
CO STATEMENT: The student will be able to		
CO1	Learn about the drug development process, innovator and generic drug concepts.	L3
CO2	Understand the regulatory guidance and guidelines for the creation of dossiers and their submission to regulatory bodies in various countries, as well as the filing and approval procedure.	L3
CO3	Learn about the regulatory organisations and authorities that control the production and distribution of medicines as well as the filing of international papers in CTD/eCTD and ASEAN formats.	L2
CO4	Recognise the pharmacovigilance, clinical trial monitoring procedures, and requirements for obtaining approvals to conduct clinical studies.	L2
CO5	Comprehension of regulatory guidance, rules, statutes, and acts, as well as fundamental vocabulary.	L3

NAME OF SUBJECT:	**COSMETIC SCIENCE**	
SUBJECT CODE :	**BP809 ET**	
BRANCH	**B.Pharm**	
SEMESTER	**8^{th}**	
SESSION	**2022-2023**	
FACULTY NAME	**Dr. Bhoomika Chaudhary**	
CO STATEMENT: The student will be able to		**Level**
CO1	Learn about the key elements used in cosmeceuticals and cosmetics.	L3
CO2	Recognise the fundamental components of cosmetics for a variety of compositions.	L3
CO3	Understanding the most recent technologies available	L2
CO4	Knowing scientific concepts will help you create cosmetics and cosmeceuticals with the desired level of safety.	L2
CO5	Application of cosmetics to a variety of diseases.	L3

NAME OF SUBJECT:	**DIETARY SUPPLEMENTS AND NUTRACEUTICALS**	
SUBJECT CODE :	**BP812 ET**	
BRANCH	**B.Pharm**	
SEMESTER	**8^{th}**	
SESSION	**2022-2023**	
FACULTY NAME	**Dr. Bhoomika Chaudhary**	**Level**
CO STATEMENT: The student will be able to		
CO1	Recognise how diverse groups of individuals require supplements to maintain healthy lives.	L3
CO2	Recognise how diverse groups of people need supplements to sustain healthy lives and what happens when dietary supplements are deficient.	L3
CO3	Learn about the generation of free radicals and their negative effects on lipids, proteins, carbohydrates, nucleic acids, and study on complex carbs and dietary fibre.	L2
CO4	Know how free radicals affect different disorders and ageing, the value of different antioxidants, and how different environmental circumstances affect the effectiveness of nutraceuticals.	L2
CO5	Recognise the dietary supplement industry's commercial and regulatory components, including health claims, to learn about food adulteration.	L3

NAME OF SUBJECT:	PHARMACEUTICAL PRODUCT DEVELOPMENT	
SUBJECT CODE :	BP813 ET	
BRANCH	B.Pharm	
SEMESTER	8th	
SESSION	2022-2023	
FACULTY NAME	Dr. Bhoomika Chaudhary	Level
CO STATEMENT: The student will be able to		
CO1	Describe the evolution of pharmaceutical products.	L3
CO2	Understand pharmaceutical ingredients	L3
CO3	By using quality by design (QbD) methods, pharmaceutical product development can be improved.	L2
CO4	Excipients are used in therapeutic compositions.	L2
CO5	Conduct various formulation quality control tests.	L3

Programme outcome of Pharm.D After completion graduate are ready to	
PO1-Pharmacy knowledge	Possess knowledge and comprehension of the core and basic knowledge pertaining to the profession of pharmacy, including biomedical sciences; pharmaceutical sciences; clinical practices
PO2-Clinical Pharmacy Practice	Develop competency in analysing and interpretation skills in medical emergency and provide high quality therapy in all areas of clinical care and monitoring including structure based therapeutic evaluation. appreciate the concept of Rational drug therapy in diverse therapeutic intervention. Provide high quality evidence based patient-centric care with clinician.
PO3-Problem Analysis	Develop ability to utilize the principles of scientific enquiry and improves critical thinking in order to identify, formulate and solve the issues related to Patient care.
PO4-Modern tool Usage	Learn, select and apply appropriate techniques, and efficient utilization of resources, software's for overcoming the limitations of conventional practices.
PO5-Communication skills	Communicate effectively regarding issues related to patient specific with the pharmacy community and society.
PO6-Professional Identity	Act in consultative position with other healthcare
PO7-Pharmaceutical Ethics	Honour personal values and apply ethical values in professional and social context. Demonstrate high degree of professional, ethical and legal manners, conforming with all national, state and local rules and regulations related to pharmacy practice.
PO8-Planning Abilities	Develop and apply skills for time management and utilization of resources and implement them to complete the task to meet deadlines.
PO9-Leadership skills	Inculcate leadership abilities for competent team-centric approaches to improve and facilitate the health and well-being of society.
PO10-Environment and sustainability :	Recognize the need to engage independent and lifelong learning to update the practice to keep in pace with the ever-changing technological aspects. Self-assessment along with feedback analysis to identify the grey areas for improvement of diverse skills as a continuous process.
PO11-Life-long learning	Recognize the need to engage independent and life long learning to update the practice to keep in pace with the ever-changing technological aspects. Self-assessment along with feedback analysis to identify the grey areas for improvement of diverse skills as a continuous process.

NAME OF SUBJECT :	Human Anatomy & Physiology
SUBJECT CODE :	22 PD 11T
BRANCH	Pharmacy
SEMESTER/YEAR	1st
SESSION	2022-2023
FACULTY NAME	Dr. Gaurav Rajauria

CO STATEMENT: The student will be able to		Level
CO1	They would have learnt the gross anatomy, histology and physiology of various organs of the human body.	L1, L2
CO2	They would identify the various tissues and organs associated with the different organ systems with help of charts and specimens.	L2, L3
CO3	They would have studied the coordination in functioning of different organs of each system.	L2, L3
CO4	They would have understood the several physiological homeostatic mechanisms and their imbalances in human body.	L2, L3
CO5	They would have learnt the interlinked mechanisms in the maintenance in normal and physical exercise conditions.	L2, L3, L4

Alignment/Mapping of COs & PSOs (Course Articulation Matrix)

(a) CO Mapping with Assessment tools

Course Outcomes	Sessional 1	Sessional 2	Sessional 3	End Term Exam
CO PD 11.1	✓			✓
CO PD 11.2	✓		✓	✓
CO PD 11.3	✓	✓	✓	✓
CO PD 11.4		✓	✓	✓
CO PD 11.5		✓		✓

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1													2	
2														3
3													3	2
4													2	3
5													3	4
Avg.														

NAME OF SUBJECT :	Pharmaceutics
SUBJECT CODE :	22 PD 12T
BRANCH	Pharmacy
SEMESTER/YEAR	1st
SESSION	2022-2023
FACULTY NAME	Dr. Gaurav Rajauria

CO STATEMENT: The student will be able to		Level
CO1	Upon completion of this program the student will know different dosages aspects	L1, L2
CO2	Different dosage forms	L2, L3
CO3	Different pharmaceutical calculation	L2, L3
CO4	The importance of good formulation for effectiveness.	L2, L3
CO5	Preparation, handling and storage of dosage forms	L2, L3, L4

Alignment/Mapping of COs & PSOs (Course Articulation Matrix)

(a) CO Mapping with Assessment tools

Course Outcomes	Sessional 1	Sessional 2	Sessional 3	End Term Exam
CO PD 12.1	✓			✓
CO PD 12.2	✓		✓	✓
CO PD 12.3	✓	✓	✓	✓
CO PD 12.4		✓	✓	✓
CO PD 12.5		✓		✓

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1													2	
2														3
3													3	2
4													2	3
5													3	4
Avg.														

NAME OF SUBJECT :	Medicinal Biochemistry
SUBJECT CODE :	22 PD 13T
BRANCH	Pharmacy
SEMESTER/YEAR	1st
SESSION	2022-2023
FACULTY NAME	Dr. Gaurav Rajauria

CO STATEMENT: The student will be able to		Level
CO1	To understand the importance of metabolism of substrates.	L1, L2
CO2	Will acquire chemistry and biological importance of biological macromolecules.	L2, L3
CO3	To acquire knowledge in qualitative and quantitative estimation of the biological macromolecules.	L2, L3
CO4	To know the interpretation of data emanating from a Clinical Test Lab.	L2, L3
CO5	To know how physiological conditions influence the structures and reactivity's of biomolecules.	L2, L3, L4

Alignment/Mapping of COs & PSOs (Course Articulation Matrix)

(a) CO Mapping with Assessment tools

Course Outcomes	Sessional 1	Sessional 2	Sessional 3	End Term Exam
CO PD 13.1	✓			✓
CO PD 13.2	✓		✓	✓
CO PD 13.3	✓	✓	✓	✓
CO PD 13.4		✓	✓	✓
CO PD 13.5		✓		✓

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1													2	
2														3
3													3	2
4													2	3
5													3	4
Avg.														

NAME OF SUBJECT :	Pharmaceutical Organic Chemistry
SUBJECT CODE :	22 PD 14T
BRANCH	Pharmacy
SEMESTER/YEAR	1st
SESSION	2022-2023
FACULTY NAME	Dr. Gaurav Rajauria

CO STATEMENT: The student will be able to		Level
CO1	To be able to give systematic names to simple organic compounds and poly functional group.	L1, L2
CO2	To achieve an understanding of the behavior of organic compounds and to establish a foundation for studies into natural and synthetic products of pharmaceutical interest.	L2, L3
CO3	To acquire the knowledge and understanding of the basic experimental principles of pharmaceutical organic chemistry.	L2, L3
CO4	To draw the structures and synthesize simple pharmaceutically active organic compounds.	L2, L3
CO5	To describe detailed mechanisms for common reactions.	L2, L3, L4

Alignment/Mapping of COs & PSOs (Course Articulation Matrix)

(a) CO Mapping with Assessment tools

Course Outcomes	Sessional 1	Sessional 2	Sessional 3	End Term Exam
CO PD 14.1	✓			✓
CO PD 14.2	✓		✓	✓
CO PD 14.3	✓	✓	✓	✓
CO PD 14.4		✓	✓	✓
CO PD 14.5		✓		✓

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1													2	
2														3
3													3	2
4													2	3
5													3	4
Avg.														

NAME OF SUBJECT :	Pharmaceutical Inorganic Chemistry
SUBJECT CODE :	22 PD 15T
BRANCH	Pharmacy
SEMESTER/YEAR	1st
SESSION	2022-2023
FACULTY NAME	Dr. Gaurav Rajauria

CO STATEMENT: The student will be able to		Level
CO1	Well acquainted with the principles of limit tests.	L1, L2
CO2	Understand the principles and procedures of analysis of drugs and also regarding the application of inorganic pharmaceutical.	L2, L3
CO3	Knowledge about the sources of impurities and methods to determine the impurities in inorganic drugs and pharmaceuticals	L2, L3
CO4	Appreciate the importance of inorganic pharmaceuticals in preventing and curing the disease.	L2, L3
CO5	To have been introduced to a variety of inorganic drug classes.	L2, L3, L4

Alignment/Mapping of COs & PSOs (Course Articulation Matrix)

(a) CO Mapping with Assessment tools

Course Outcomes	Sessional 1	Sessional 2	Sessional 3	End Term Exam
CO PD 15.1	✓			✓
CO PD 15.2	✓		✓	✓
CO PD 15.3	✓	✓	✓	✓
CO PD 15.4		✓	✓	✓
CO PD 15.5		✓		✓

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1													2	
2														3
3													3	2
4													2	3
5													3	4
Avg.														

NAME OF SUBJECT :	Remedial Mathematics/Biology
SUBJECT CODE :	22 PD 16T
BRANCH	Pharmacy
SEMESTER/YEAR	1st
SESSION	2022-2023
FACULTY NAME	Dr. Gaurav Rajauria

CO STATEMENT: The student will be able to		Level
CO1	Apply mathematical concepts and principles to perform computations for Pharmaceutical Sciences.	L1, L2
CO2	Create, use and analyze mathematical representations and mathematical relationships	L2, L3
CO3	Cell biology (Basic Nature of Plant cell and Animal cell)	L2, L3
CO4	Classification System of both Plants & Animals	L2, L3
CO5	Various tissue system and organ system in plant and animals	L2, L3, L4

Alignment/Mapping of COs & PSOs (Course Articulation Matrix)

(a) CO Mapping with Assessment tools

Course Outcomes	Sessional 1	Sessional 2	Sessional 3	End Term Exam
CO PD 16.1	✓			✓
CO PD 16.2	✓		✓	✓
CO PD 16.3	✓	✓	✓	✓
CO PD 16.4		✓	✓	✓
CO PD 16.5		✓		✓

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1													2	
2														3
3													3	2
4													2	3
5													3	4
Avg.														

NAME OF SUBJECT :	Pathophysiology
SUBJECT CODE :	22 PD 21T
BRANCH	Pharmacy
SEMESTER/YEAR	2nd
SESSION	2022-2023
FACULTY NAME	Dr. Gaurav Rajauria

CO STATEMENT: The student will be able to		Level
CO1	Students will define the basic pathogenesis of human disease.	L1, L2
CO2	Students will define and explore the most common etiologies and predisposing factors associated with human disease	L2, L3
CO3	Students understands the basis for some laboratory tests and other diagnostic procedures	L2, L3
CO4	Students will make correlations between pathophysiology and clinical skills they are learning in their allied health science programs.	L2, L3
CO5	Students will understand how the various organ systems are interrelated, and use this understanding to promote a holistic approach towards the evaluation and treatment of patients	L2, L3, L4

Alignment/Mapping of COs & PSOs (Course Articulation Matrix)

(a) CO Mapping with Assessment tools

Course Outcomes	Sessional 1	Sessional 2	Sessional 3	End Term Exam
CO PD 21.1	✓			✓
CO PD 21.2	✓		✓	✓
CO PD 21.3	✓	✓	✓	✓
CO PD 21.4		✓	✓	✓
CO PD 21.5		✓		✓

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1													2	
2														3
3													3	2
4													2	3
5													3	4
Avg.														

NAME OF SUBJECT :	Pharmaceutical Microbiology
SUBJECT CODE :	22 PD 22T
BRANCH	Pharmacy
SEMESTER/YEAR	2nd
SESSION	2022-2023
FACULTY NAME	Dr. Gaurav Rajauria

CO STATEMENT: The student will be able to		Level
CO1	Students can able to demonstrate an understanding at an advanced level of microbial virulence mechanisms and host response to infection; application of molecular techniques to medical microbiology; microbial susceptibility and resistance to antimicrobial agents; replication of viruses, viral immunology and pathogenesis, detection of viruses	L1, L2
CO2	Students can able to understanding of various infections (microbial causes, pathogenesis, transmission of infection, diagnosis, prevention and treatment) by being able to identify a unknown organisms in clinical samples, and describe the pathogenesis of important pathogens	L2, L3
CO3	Students Demonstrate a basic understanding of the pathogenesis of some important fungal infections of humans, and be able to identify and isolate them from clinical samples	L2, L3
CO4	Students Work cooperatively as part of a small group and Critically assess and interpret scientific literature	L2, L3
CO5	Students can Analyze and report on complex research questions, and solve problems, plan a work program or diagnostic strategy and learn independently	L2, L3, L4

Alignment/Mapping of COs & PSOs (Course Articulation Matrix)

(a) CO Mapping with Assessment tools

Course Outcomes	Sessional 1	Sessional 2	Sessional 3	End Term Exam
CO PD 22.1	✓			✓
CO PD 22.2	✓		✓	✓
CO PD 22.3	✓	✓	✓	✓
CO PD 22.4		✓	✓	✓
CO PD 22.5		✓		✓

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1													2	
2														3
3													3	2
4													2	3

5													3	4
Avg.														

NAME OF SUBJECT :	Pharmacognosy & Phytopharmaceuticals
SUBJECT CODE :	22 PD 23T
BRANCH	Pharmacy
SEMESTER/YEAR	2nd
SESSION	2022-2023
FACULTY NAME	Dr. Gaurav Rajauria

CO STATEMENT: The student will be able to		Level
CO1	Herbs and their Science	L1, L2
CO2	Classification of Medicinal Plants, Phytochemistry, Carbohydrates, Lipids	L2, L3
CO3	Terpenes, Polyphenols, Alkaloids, Pharmacology, Toxicity, Formulations and Preparations of Herbal Medicines	L2, L3
CO4	How herbs influence our physiology and can be helpful against several disorders.	L2, L3
CO5	Relationsbetween Phyto-therapy and the Elderly, Phytotherapy and Children, Understanding Herbal Action, and Understanding the Materia Medica.	L2, L3, L4

Alignment/Mapping of COs & PSOs (Course Articulation Matrix)

(a) CO Mapping with Assessment tools

Course Outcomes	Sessional 1	Sessional 2	Sessional 3	End Term Exam
CO PD 23.1	✓			✓
CO PD 23.2	✓		✓	✓
CO PD 23.3	✓	✓	✓	✓
CO PD 23.4		✓	✓	✓
CO PD 23.5		✓		✓

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1													2	
2														3
3													3	2
4													2	3
5													3	4
Avg.														

NAME OF SUBJECT :	Pharmacology I
SUBJECT CODE :	22 PD 24T
BRANCH	Pharmacy
SEMESTER/YEAR	2nd
SESSION	2022-2023
FACULTY NAME	Dr. Gaurav Rajauria

CO STATEMENT: The student will be able to		Level
CO1	The student would have learnt about the different drugs used with an emphasis on its classification, Pharmacodynamic and pharmacokinetic aspects, adverse effects, Therapeutic uses.	L1, L2
CO2	They would have studied, dose, route of administration, precautions, and contraindications.	L2, L3
CO3	They would have understood the pharmacological aspects of drugs used to treat ailment of different organ systems of the body.	L2, L3
CO4	They would appreciate the importance of drug discovery by preclinical and clinical trials.	L2, L3
CO5	They would appreciate the importance of pharmacology	L2, L3, L4

Alignment/Mapping of COs & PSOs (Course Articulation Matrix)

(a) CO Mapping with Assessment tools

Course Outcomes	Sessional 1	Sessional 2	Sessional 3	End Term Exam
CO PD 24.1	✓			✓
CO PD 24.2	✓		✓	✓
CO PD 24.3	✓	✓	✓	✓
CO PD 24.4		✓	✓	✓
CO PD 24.5		✓		✓

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1													2	
2														3
3													3	2
4													2	3
5													3	4
Avg.														

NAME OF SUBJECT :	Community Pharmacy
SUBJECT CODE :	22 PD 25T
BRANCH	Pharmacy
SEMESTER/YEAR	2^{nd}
SESSION	2022-2023
FACULTY NAME	Dr. Gaurav Rajauria

CO STATEMENT: The student will be able to		Level
CO1	Students will provide patient cantered care to diverse patients using the best available evidence and in consideration of patients' circumstances to devise, modify, implement, document and monitor pharmacotherapy care plans, either independently or as part of healthcare team	L1, L2
CO2	Students will demonstrate knowledge of the business and professional practice management skills in community pharmacies.	L2, L3
CO3	Students will educate patients through counselling &provide health screening services to public	L2, L3
CO4	Students will identify symptoms of minor ailments and provide appropriate medication	L2, L3
CO5	Students will participate in prevention programs of communicable diseases	L2, L3, L4

Alignment/Mapping of COs & PSOs (Course Articulation Matrix)

(a) CO Mapping with Assessment tools

Course Outcomes	Sessional 1	Sessional 2	Sessional 3	End Term Exam
CO PD 25.1	✓			✓
CO PD 25.2	✓		✓	✓
CO PD 25.3	✓	✓	✓	✓
CO PD 25.4		✓	✓	✓
CO PD 25.5		✓		✓

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1													2	
2														3
3													3	2

4													2	3
5													3	4
Avg.														

NAME OF SUBJECT :	Pharmacotherapeutics I
SUBJECT CODE :	22 PD 26T
BRANCH	Pharmacy
SEMESTER/YEAR	2nd
SESSION	2022-2023
FACULTY NAME	Dr. Gaurav Rajauria

CO STATEMENT: The student will be able to		Level
CO1	Students will be able to describe the pathophysiology and management of cardiovascular, respiratory and endocrine diseases	L1, L2
CO2	Students will be developing Patient case based Assessment Skills	L2, L3
CO3	Students will be able to describe the quality use of medicines issues surrounding the therapeutic agents in the treatment of these diseases	L2, L3
CO4	Students will have developed clinical skills in the therapeutic management of these conditions	L2, L3
CO5	Continue to develop communication skills.	L2, L3, L4

Alignment/Mapping of COs & PSOs (Course Articulation Matrix)

(a) CO Mapping with Assessment tools

Course Outcomes	Sessional 1	Sessional 2	Sessional 3	End Term Exam
CO PD 26.1	✓			✓
CO PD 26.2	✓		✓	✓
CO PD 26.3	✓	✓	✓	✓
CO PD 26.4		✓	✓	✓
CO PD 26.5		✓		✓

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1													2	
2														3
3													3	2
4													2	3
5													3	4
Avg.														

NAME OF SUBJECT :	Pharmacotherapeutics III
SUBJECT CODE :	22 PD 41T
BRANCH	Pharmacy
SEMESTER/YEAR	PB 1st
SESSION	2022-2023
FACULTY NAME	Dr. Gaurav Rajauria

CO STATEMENT: The student will be able to		Level
CO1	Initiate drug therapy and the anticipated therapeutic goals by therapeutic intervention	L1, L2
CO2	Know the effective use of non-pharmacological therapeutic interventions in the treatment of specific diseases, conditions and symptoms.	L2, L3
CO3	Demonstrate the ability to effectively communicate and work collaboratively together with others in the small group setting	L2, L3
CO4	Have moral reasoning, ethical judgement and professionalism	L2, L3
CO5	Students will have developed clinical skills in the therapeutic management of these conditions	L2, L3, L4

Alignment/Mapping of COs & PSOs (Course Articulation Matrix)

(a) CO Mapping with Assessment tools

Course Outcomes	Sessional 1	Sessional 2	Sessional 3	End Term Exam
CO PD 41.1	✓			✓
CO PD 41.2	✓		✓	✓
CO PD 41.3	✓	✓	✓	✓
CO PD 41.4		✓	✓	✓
CO PD 41.5		✓		✓

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1													2	
2														3
3													3	2
4													2	3
5													3	4

Avg.														

NAME OF SUBJECT :	Hospital Pharmacy
SUBJECT CODE :	22 PD 42T
BRANCH	Pharmacy
SEMESTER/YEAR	PB 1st
SESSION	2022-2023
FACULTY NAME	Dr. Gaurav Rajauria

CO STATEMENT: The student will be able to		Level
CO1	Know Various Drug Distribution Methods;	L1, L2
CO2	Know The Professional Practice Management Skills In Hospital Pharmacies;	L2, L3
CO3	Provide Unbiased Drug Information To The Doctors;	L2, L3
CO4	Know The Manufacturing Practices Of Various Formulations In Hospital Set Up;	L2, L3
CO5	Appreciate The Practice Based Research Methods	L2, L3, L4

Alignment/Mapping of COs & PSOs (Course Articulation Matrix)

(a) CO Mapping with Assessment tools

Course Outcomes	Sessional 1	Sessional 2	Sessional 3	End Term Exam
CO PD 42.1	✓			✓
CO PD 42.2	✓		✓	✓
CO PD 42.3	✓	✓	✓	✓
CO PD 42.4		✓	✓	✓
CO PD 42.5		✓		✓

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1													2	
2														3
3													3	2
4													2	3
5													3	4

Avg.														

NAME OF SUBJECT :	Clinical Pharmacy
SUBJECT CODE :	22 PD 43T
BRANCH	Pharmacy
SEMESTER/YEAR	PB 1st
SESSION	2022-2023
FACULTY NAME	Dr. Gaurav Rajauria

CO STATEMENT: The student will be able to		Level
CO1	Monitor drug therapy of patient through medication chart review and clinical review;	L1, L2
CO2	Obtain medication history interview and counsel the patients;	L2, L3
CO3	Identify and resolve drug related problems;	L2, L3
CO4	Detect, assess and monitor adverse drug reaction;	L2, L3
CO5	Interpret selected laboratory results (as monitoring parameters in therapeutics) of specific disease states;	L2, L3, L4

Alignment/Mapping of COs & PSOs (Course Articulation Matrix)

(a) CO Mapping with Assessment tools

Course Outcomes	Sessional 1	Sessional 2	Sessional 3	End Term Exam
CO PD 43.1	✓			✓
CO PD 43.2	✓		✓	✓
CO PD 43.3	✓	✓	✓	✓
CO PD 43.4		✓	✓	✓
CO PD 43.5		✓		✓

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1													2	
2														3
3													3	2
4													2	3
5													3	4
Avg.														

NAME OF SUBJECT :	Biostatistics & Research Methodology
SUBJECT CODE :	22 PD 44T
BRANCH	Pharmacy
SEMESTER/YEAR	PB 1st
SESSION	2022-2023
FACULTY NAME	Dr. Gaurav Rajauria

CO STATEMENT: The student will be able to		Level
CO1	Know the various statistical methods to solve different types of problems	L1, L2
CO2	Operate various statistical software packages	L2, L3
CO3	Appreciate the importance of Computer in hospital and Community Pharmacy	L2, L3
CO4	Appreciate the statistical technique in solving the pharmaceutical problems	L2, L3
CO5	Research Parameters	L2, L3, L4

Alignment/Mapping of COs & PSOs (Course Articulation Matrix)

(a) CO Mapping with Assessment tools

Course Outcomes	Sessional 1	Sessional 2	Sessional 3	End Term Exam
CO PD 44.1	✓			✓
CO PD 44.2	✓		✓	✓
CO PD 44.3	✓	✓	✓	✓
CO PD 44.4		✓	✓	✓
CO PD 44.5		✓		✓

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1													2	
2														3
3													3	2
4													2	3
5													3	4

Avg.														

NAME OF SUBJECT :	Biopharmaceutics & Pharmacokinetics
SUBJECT CODE :	22 PD 45T
BRANCH	Pharmacy
SEMESTER/YEAR	PB 1st
SESSION	2022-2023
FACULTY NAME	Dr. Gaurav Rajauria

CO STATEMENT: The student will be able to		Level
CO1	Broader understanding about the concepts of biopharmaceutics and pharmacokinetics.	L1, L2
CO2	Ability to calculate the various pharmacokinetic parameters by using various mathematical models.	L2, L3
CO3	Ability to design a basic protocol for the conduct of BA/BE study and the interpretation of the BA/BE data	L2, L3
CO4	Preparedness to use the concepts of pharmacokinetic principles in the clinical contexts.	L2, L3
CO5	Ability to design and perform *in-vitro* dissolution studies for various drugs as per the standards of official monographs	L2, L3, L4

Alignment/Mapping of COs & PSOs (Course Articulation Matrix)

(a) CO Mapping with Assessment tools

Course Outcomes	Sessional 1	Sessional 2	Sessional 3	End Term Exam
CO PD 45.1	✓			✓
CO PD 45.2	✓		✓	✓
CO PD 45.3	✓	✓	✓	✓
CO PD 45.4		✓	✓	✓
CO PD 45.5		✓		✓

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2

1													2	
2														3
3													3	2
4													2	3
5													3	4
Avg.														

NAME OF SUBJECT :	Clinical Toxicology
SUBJECT CODE :	22 PD 46T
BRANCH	Pharmacy
SEMESTER/YEAR	PB 1st
SESSION	2022-2023
FACULTY NAME	Dr. Gaurav Rajauria

CO STATEMENT: The student will be able to		Level
CO1	Developing general working knowledge of the principles and practice of clinical toxicology	L1, L2
CO2	Demonstrating an understanding of the health implications of toxic exposures and commonly involved chemicals for toxicity	L2, L3
CO3	Demonstrating and applying an understanding of general toxicology principles and clinical management practice	L2, L3
CO4	Demonstrating and applying an understanding of the history, assessment, and therapy considerations associated with the management of a toxic exposure	L2, L3
CO5	Demonstrating and apply an understanding of the characteristics of and treatment guidelines for specific toxic substances	L2, L3, L4

Alignment/Mapping of COs & PSOs (Course Articulation Matrix)

(a) CO Mapping with Assessment tools

Course Outcomes	Sessional 1	Sessional 2	Sessional 3	End Term Exam
CO PD 46.1	✓			✓
CO PD 46.2	✓		✓	✓
CO PD 46.3	✓	✓	✓	✓
CO PD 46.4		✓	✓	✓
CO PD 46.5		✓		✓

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1													2	
2														3
3													3	2
4													2	3
5													3	4
Avg.														

NAME OF SUBJECT :	Pharmacotherapeutics I & II
SUBJECT CODE :	22 PD 47T
BRANCH	Pharmacy
SEMESTER/YEAR	PB 1st
SESSION	2022-2023
FACULTY NAME	Dr. Gaurav Rajauria

CO STATEMENT: The student will be able to		Level
CO1	The pathophysiology of selected disease states and the rationale for drug therapy.	L1, L2
CO2	The therapeutic approach to management of these diseases.	L2, L3
CO3	The controversies in drug therapy.	L2, L3
CO4	The importance of preparation of individualized therapeutic plans based on diagnosis.	L2, L3
CO5	Needs to identify the patientspecific parameters relevant in initiating drug therapy, and monitoring therapy (including alternatives, time-course of clinical and laboratory indices of therapeutic response and adverse effects).	L2, L3, L4

Alignment/Mapping of COs & PSOs (Course Articulation Matrix)

(a) CO Mapping with Assessment tools

Course Outcomes	Sessional 1	Sessional 2	Sessional 3	End Term Exam
CO PD 47.1	✓			✓
CO PD 47.2	✓		✓	✓
CO PD 47.3	✓	✓	✓	✓
CO PD 47.4		✓	✓	✓
CO PD 47.5		✓		✓

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2

1													2	
2														3
3													3	2
4													2	3
5													3	4
Avg														

Appendix-

DEPARTMENT OF MICROBIOLOGY
B.Sc. (in Faculty of Life Science)
(Based on Choice Based Credit System)
SUBJECT: MICROBIOLOGY
SYLLABUS
Under NEP-2020

SEMESTER WISE PAPER TITLES WITH DETAILS

Semester	Course code	Paper/title	CIE	End Semester Examination	Total	Credits	Teaching hours
B. SC. 1ST YEAR / CERTIFICATE COURSE IN MICROBIAL TECHNIQUES							
I	MBB101T	GeneralMicrobiology	25	75	100	4	60
	MBB102P	Experiments in Basic Microbiology	25	75	100	2	60
II	MBB201T	Agriculture and Environmental Microbiology	25	75	100	4	60
	MBB202P	Experiments in Agriculture and Environmental Microbiology	25	75	100	2	60
B. SC. 2ND YEAR / DIPLOMA IN MICROBIAL TECHNOLOGY							
III	MBB301T	Basic Biochemistry and Microbial Physiology	25	75	100	4	60
	MBB302P	Experiments in Basic Biochemistry and Microbial Physiology	25	75	100	2	60
IV	MBB401T	Molecular Biology and Microbial Genetics	25	75	100	4	60
	MBB402P	Experiments in Molecular Biology and Microbial Genetics	25	75	100	2	60
B. SC. 3RD YEAR / DEGREE IN BACHELOR OF SCIENCE (IN FACULTY OF LIFE SCIENCE)							
V	MBB501T	MedicalMicrobiology	25	75	100	4	60
	MBB502T	Immunology	25	75	100	4	60
	MBB503P	Experiments in Medical Microbiology& Immunology	25	75	100	2	60
VI	MBB601T	Food Microbiology	25	75	100	4	60
	MBB602T	Industrial Microbiology	25	75	100	4	60
	MBB603P	Experiments in Food & Industrial Microbiology	25	75	100	2	60

*CIE = CONTINUOUS INTERNAL EVALUATION; T = THEORY; P= PRACTICAL

20/5/22 20/5/22 20/5/2022

Programme Objectives(POs)

1. The programme has been designed in such a way so that the students get exposed to strong theoretical and practical background on various domains of Microbiology.
2. The programme includes details of important microorganisms of agricultural, medical and industrial importance, biomolecules, tools and techniques, enzymes, immunology, cell biology, molecular biology genetic engineering to make the study of microbiology for sustainable development of human society.
3. The practical courses have been designed to equip the students with the laboratory skills in microbiology. Students will able to design and conduct experiments, as well as to analyze and interpret scientific data
4. The programme will provide students with the knowledge and skill base that would enable them to undertake further studies in microbiology and related areas or in multidisciplinary areas that involve microbiology, biochemistry, biotechnology and molecular biology and help develop arrange of generic skills that are relevant in enhancing entrepreneurship skills among students
5. The students will be exposed to a wide range of careers that combine microbiology, environment, industry and medical.

Certificate Course in Microbial Techniques

B.Sc. 1st Programme Specific Outcomes (PSOs)

PSO1	Students will be able to acquire, articulate, retain, and apply specialized skills and knowledge relevant to microbiology.
PSO2	Students will be able to appreciate the diversity of microorganisms and microbial communities inhabiting a multitude of habitats, understand their pathogenic as well beneficial significance to man and nature.
PSO3	Students will acquire and demonstrate proficiency in good laboratory practices in a Microbiological laboratory and be able to explain the theoretical basis and practical skills of the tools/technologies commonly used to study this field.
PSO4	Students will gain fundamental knowledge about the various scopes on agricultural and environmental microbiology and their concepts.
PSO5	The certificate course will enable students to apply for technical positions in government and private labs/institutes.

2/5/22

Diploma in Microbial Technology	
B.Sc. 2nd year Programme based outcomes	
PSO1	Students will develop familiarity and understanding of the microbiology concepts as relevant to Various areas such as biochemistry, microbial physiology, molecular biology and genetics.
PSO2	Students will exhibit reasonable abilities in the utilization of instruments, advances and Techniques common to microbiology, and apply the logical strategy and theory testing in the plan and execution of examinations.
PSO3	Students will be adequately capable to utilize microbiology information and abilities to analyze problems involving microorganisms, articulate these with peers and undertake remedial measures.
PSO4	Students will be able to describe how microorganisms obtain energy, metabolism, reproduction, survival, and interactions with their environment, hosts, and host populations.
PSO5	Students will be able to work in a variety of fields, including biological and medical science in higher education institutions, public health, environmental organizations, and the food, dairy, pharmaceutical, and biotechnology industries.

Degreein Bachelor of Science	
B. Sc. 3rd year Programme Specific Outcomes (PSOs)	
PSO1	Students of B.Sc. Microbiology Programme will learn to use scientific logic as they investigate abroad variety of contemporary subjects covering different areas of basic microbiology such as Bacteriology, Virology, Biochemistry, Microbial Physiology, Immunology, Cell Biology, Molecular Biology, Genetics, Immunology, and Microbial Genetics, as well as becoming aware of the importance of environmental microbiology.
PSO2	Students will earn about various biotechnological applications of microorganisms as well as industrially relevant substances developed by microorganisms. They'll learn about the special Role microbes play in genetic modification technologies.
PSO3	Students will learn and develop good laboratory practices in a microbiological laboratory, as wellas be able to explain the theoretical foundations and practical skills of the tools and technologies widely used in this area. Students can gain proficiency in the quantitative skills needed to analyze biological problems.
PSO4	Students will learn about experimental methods, hypothesis creation and testing, and experimentdesign and execution. Students can develop their critical thinking skills as well as their ability toread and interpret scientific literature. Via successful presentation of experimental findings as well as workshops, students can acquire good oral and written communication skills.
PSO5	The Degree courses will enable students to go for higher studies in Microbiology and Allied Subjects leading to Post Graduation and Ph.D. degrees.

Programme/Class: Certificate	**Year:First**	**Semester:First**
Subject: MICROBIOLOGY		
Course Code:MBB101T	**Course Title: General Microbiology**	

CourseOutcomes:
The student at the completion of the course will be able to:

- To understand the history, relevance of microbiology and classification of microbes.
- To learn and understand the microbial diversity in the living world.
- To understand the working of various microscopes and their applications.
- To gain knowledge of various (physical and chemical) methods of control of microorganisms and safety measures to be followed while handling microbes.
- To demonstrate and understanding of bacterial, fungal, cyanobacterial, algal, viral and rickettesial classification, culturing, reproduction and significance.
- To learn different methods of staining of microbes.
- To understand, learn and gain skill of isolation, culturing and maintenance of pure culture.
- To enable the students to get sufficient knowledge in principles and applications of bio-instruments.
- To help students gain knowledge about antibiotics and other chemotherapeutic agents.

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): **L-T-P:4-0-0**

Unit	Topics	TotalNo. of Lectures/ Hours(60)
I	**Introduction, history and scope of Microbiology** History, scope, branches of microbiology and relevance of microbiology; Contribution of Antony Van Leeuwenhoek, Edward Jenner, Louis Pasteur, Robert Koch, Joseph Lister, Alexander Fleming, Ivanowsky, Waksman, Subba Rao, Sambhunath De. Position of microorganisms in the living world. 5kingdom classification of Whittaker and 3 kingdom classification, comparison of the 3 domain of microorganisms-bacteria, archaea, eukarya; Introduction to classification of bacteria: Bergey's manual.	8
II	**Bacterial morphology** Ultrastructure of bacterial cell, cell wall, plasma membrane, capsule, flagella, nucleoid and reserve material. Differences between archae bacterial and eubacterial cell. General features of Rickettsia, Chlamydia, Mollicutes, Actinomycetes and Cynobacteria. **Theviruses** General properties and structure of: Animal viruses: Influenza, HIV. Plant viruses: TMV. bacterial viruses: Lambda Phage and T4 bacteriophage; General features of Prions and Viroids. **Fungi** General characteristics, classification & reproduction of Saccharomyces, *Aspergillus*. **Protozoa** General characteristics, classification & reproduction of Giardia, Entamoeba	10
III	**Techniques in Microbiology I** Principles of microscopy, construction and application of-	6

	Compound Microscope (monocular and binocular), Bright field Microscopy, Dark field Microscopy, Phase Contrast Microscopy, Fluorescence Microscopy, Electron Microscopy-TEM and SEM	
IV	**Techniques in microbiology II** Principles, construction and application of centrifuge; bacteriological Incubator & Incubator Shaker; Laminar flow; Colorimeter & Spectrophotometer (UV-Vis)	6
V	**Sterilization techniques and control of microorganisms** Definitions of terms- sterilization and disinfection; Sterilization by Physical methods-Use of moist heat-heat under pressure, autoclave, boiling, pasteurization, fractional sterilization, tyndallization; Use of dry heat- hot air oven, incineration ; Filtration-Seitz filter, membrane filter, HEPA filter; Radiation- Ionizing and non-ionizing; Chemical methods-Alcohols, aldehydes, phenols, halogens, metallic salts, ethylene oxide.	7
VI	**Isolation, cultivation and preservation of microorganisms** Culture media and its types; Methods for enumeration & isolation of microorganisms using pour plate, spread plate technique and streak plate; Isolation of anaerobic microorganisms; Maintenance and preservation of pure culture	8
VII	**Stains and staining techniques** Staining techniques, principles, procedures and applications of Simple staining, negative staining; Differential staining-Gram's staining, acid fast staining, Leishman's staining, Giemsa's staining, Ziehl Neelsen staining; Structural staining-cell wall, capsule, endospore and flagella staining.	7
VIII	**Biostatistics** Introduction to biostatistics–definition statistical methods, biological measurement, kinds of biological data; Measure of central tendency – Mean, median, mode, standard deviation; Collection of data, sampling and sampling design, classification and tabulation, types of representation, graphic bio diagrams.	8

Suggested Readings:

1. Alexopoulas C.J. and Mims C.W., Introductory Mycology, New Age International, NewDelhi.
2. Aneja K.R., Experiments in Microbiology, plant pathology, Tissue culture and Mushroom cultivation, New Age International, New Delhi.
3. Atlas R.M., Microbiology-Fundamentals and applications, Macmillan Publishing Company, New York.
4. Benson Harold J., Microbiological Applications, WCB Mcgraw- Hill, NewYork.
5. Bold H.C. and Wynne M.J., Introduction to Algae, Prentice Hall of India Private Limited, New Delhi.
6. Baveja C.P., Text book of microbiology APC 6th edition.
7. Dubey R.C., and Maheshwari D. K., Text book of microbiology, S Chand Publications.
8. Pelczar M.J., Chan E.C. S and Kreig N.R., Microbiology, Mcgraw- Hill Book Company, New York.
9. Prescott Lansing M., Harley John P. and Klein Donald A., Microbiology, WCB Mcgraw-Hill, NewYork.
10. Stanier R.Y., Ingraham J.L., General Microbiology, Prentice Hall of India Private Limited, New Delhi.

11. Sharma P.D., Microbiology, Rastogi Publications.
12. Tortora G.J., Funke B.R. and Case C.L., Microbiology: An introduction, 9th edition, Pearson Education.
13. Suggestive digital platforms weblinks-
    - https:/www.classcentral.com/tag/microbiology
    - https://cmp.berkeey.edu/bacteria/bacteria.html
    - https://www.livescience.com/53272-what-is-a-virus.html
    - https://www.slideshare.net/sardar1109/algae-notes-1
    - https://www.sciencedirect.com/topics/earth-and-planetary-sciences/microscopy
    - https://onlinecourses.swayam2.ac.in/cec19_bt11/preview
    - https://microbenotes.com/laminar-flow-hood
    - https://physics.fe.uni-lj.si/students/predavanja/MicroscopyKulkarni.pdf

Suggested Continuous Evaluation Methods:

Total marks: 25

One Test/Assignments (hand written or typed 500 -1500 words)/Quizzes/ Presentationetc.(as decided by the teacher) carrying Maximum Marks 20 and a Viva-Voce/Class interaction of 5 marks.

21/5/22

Programme/Class: Certificate	Year:First	Semester:First
Subject: MICROBIOLOGY		
Course Code: MBB102P	Course Title: Experiments in Basic Microbiology	

Course Outcomes:

The student at the completion of the course will be able to:

The student at the completion of the course will be able to: To understand the instruments, microbial techniques and good lab practices for working in a microbiology laboratory.

- To understand the instruments, microbial techniques and good lab practices for working in a microbiology laboratory.
- Practical skills in the laboratory experiments in microbiology.
- Develop skills for identifying microbes and using them for industrial, agricultural and environmental purpose.
- To prepare slides and stain to see the microbial cell.

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): **L-T-P:0-0-2**

S.No.	Suggested Lab /Virtual Experiment	Total No. of Lectures/ Hours (60)
1.	• Good laboratory practice in Microbiology and safety measures. • Cleaning and sterilization of glassware and equipments. • Study of aseptic technique-preparation of cotton plug, wrapping of glassware, transfer of media and Inoculum.	12
2.	• Study of instruments-Microscope, autoclave, hot air oven, laminar air flow, inoculation loop and needle, incubator, B.O.D incubator, centrifuge machine, pH meter, colony counter, seitz filter, membrane filter, colorimeter, spectrophotometer.	12
3.	• Preparation of different culture media-nutrient agar/nutrient broth for bacterial culture, PDA for fungal culture. • Enumeration of bacteria using spread plate and pour plate techniques. • Isolation of bacteria by pour plate spread plate and streak plate method.	12
4.	• Staining of bacteria- 1. Simple staining-methylene blue 2. Gram's staining 3. Acidfast staining 4. Ziehl Neelsen staining 5. Giemsa staining 6. Structural staining-capsule, endospore. 7. Staining of fungi using lactophenol and cotton blue.	12
5.	Study of permanent slide and life materials • Bacteria- Staphylococci, Streptocococci, *E. coli*	12

	• Protozoans-*Amoeba , Paramaecium, Trypanaosoma, Plasmodium, Entamoeba hystolytica.* • Helminths- *Fasciola, Taenia solium, Ascaris.* • Fungi-*Mucor, Rhizopus, Penicillium, Aspergillus, Alternaria.* • Cyanobacteria-*Chlorella, Spirulina, Nostoc, Anabaena.*	

SuggestedReadings:

1. Microbiology: A laboratory manual by J. Cappucino and C.T. Welsh, 11th edition, Pearson education,USA. 2016
2. Aneja K.R., Experiments in Microbiology, plant pathology, Tissue culture and Mushroom Cultiation,New Age International, New Delhi.
3. Dubey R.C.. and Maheshwari D.K., Textbook of practical microbiology, S Chand Publications.
4. Stanier RY, Ingraham JL, Wheelis ML and Painter PR. (2005). General Microbiology, 5th editionMcMillan.
5. Lab Virtual links-
   - https://www.classcentral.com/course/basic-concepts-in-microbiology-and-clinical-pharm-32396
   - https://www.labster.com/microbiology-virtual-labs/
   - https://www.futurelearn.com/courses/basic-concepts-in-microbiology-and-clinical-pharmacology-of-antimicrobials

Suggested Continuous Internal Evaluation (CIE) methods

Totalmarks: 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: Certificate	Year:First	Semester: Second
Subject: MICROBIOLOGY		
Course Code: MBB201T	Course Title: Agriculture and Environmental Microbiology	

Course Outcomes:

The student at the completion of the course will be able to:

- Get acquainted with natural habitats of diverse protection.
- Understand how microbes interact among themselves and with higher plants and animals with the helpof various examples.
- Become aware of the important role microbes play in bio-geochemical cycling of essential elementsoccurring within an ecosystem and its significance.
- Gain in depth knowledge of different types of solid waste, liquid waste and their management.
- Get familiar with problems of pollution and applications of clear up technologies for the pollutants.
- Know about the diverse microbial populations in various natural habitats like soil, air, water.
- Gain knowledge of the bio-fertilizer and their types.

Credits:4	Core:Compulsory
Max.Marks CIE:25 Max.Marks End Semester Examination:75 Total Max. Marks: 100	Min.PassingMarks CIE:09 Min. Passing Marks End Semester Examination: 26 Total Min. Passing Marks: 35

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:4-0-0

Unit	Topics	Total No. of Lectures/Hours (60)
I	**Microorganisms and their habitats** Structure and function of ecosystem; Terrestrial environment: soil profile and soil microflora; Aquatic Environment: microflora of fresh water and marine habitats; Atmosphere: Aeromicroflora and dispersion of microbes; Animal Environment: Microbes in/ on human body (microbiomes) & animal (Ruminants) body; Extreme habitats: Extremophiles: Microbes thriving at high & low temperature, pH. High hydrostatic & osmotic pressures, salinity and low Nutrient level; Microbial succession in decomposition of plant organic matter.	8
II	**Microbial Interactions** Microbe interactions: Mutualism, synergism, commensalism, competition, amensalism, parasitism, predation; Microbe-Plant interaction: positive-negative interaction; Microbe-Animal interaction: positive-negative interaction; Microorganism of rhizosphere, rhizoplane and phylloplane, mycorrhiza(types And its applications).	8
III	**Biogeochemicalcycling** Carbon cycle: Microbial degradation of cellulose, hemicellulase, lignin andchitin; Nitrogen cycle: Nitrogen fixation, ammonification, nitrification, denitrification and nitrate reduction; Phosphorous cycle: Phosphate Immobilisation and solubilisation; Sulphur cycle: Microbes involved in sulphur cycle.	8

2/5/22

IV	**Wastemanagement** Solid waste management: Source and type of solid waste, method of solid waste disposal (composting and sanitary landfill), Liquid waste management: composition and strength of sewage (BOD & COD), primary, secondary, (oxidation pond, trickling filter, activated sludge process and septic tank) and tertiary sewage treatment.	8
V	**MicrobialBioremediation** Principle and degradation of common pesticides, organic (hydrocarbon, oil spills) and inorganic matter, biosurfactants.	6
VI	**Water potablity** Treatment and safety of drinking water; Methods to detect potability of water sample: Standard qualitative procedure- MPN test/Presumptive test, confirmed and completed test for faecal - coliforms Membrane filter technique. Presence/Absencetestfecalcoliform.	6
VII	**Biofertilizer** Definition, Types- Bacterial, Fungal, Phosphate solubilizer, BGA & associative;Mode of application; Advantages and Disadvantages.	8
VIII	**Biopesticides** Introduction and definition; Types of biopesticides; Integrated pest management (IPM); Mode of action; Factor influencing; Applications, advantages & disadvantages.	8

SuggestedReadings:

1. Alexander M., Introduction to soil microbiology, Wiley Eastern limited, New Delhi.
2. Alexopoulas C.J. and MIMS C.W., Introductory Mycology, New age international, New Delhi.
3. Aneja K.R., Experiments in Microbiology, plant pathology, Tissue culture and Mushroom cultivation,New Age International, New Delhi
4. Hurst, C.J., Environmental Microbiology, ASM press, Washington D.C.
5. Mehrotra A.S., Plant Pathology, Tata Mcgraw Hill Publications limited, New Delhi.
6. Pelczar M.J., Chan E.C.S and Kreig N.R., Microbiology, Mcgraw-Hill Book Company, New York.
7. Prescott Lansing M., Harley John P. and Klein Donald A., Microbiology, WCB Mcgraw- Hill, NewYork.
8. Salle A.J., Fundamental Principles of Bacteriology, Tata Mcgraw-Hill Publishing Company Limited,New Delhi.
9. Stacey R.H. and Evans H.J., Biological Nitrogen Fixation, Chapman and Hall limited, London.
10. Stanier R.Y., Ingraham J.L., General Microbiology, Prentice Hall of India Private Limited, New Delhi.
11. Subbarao N.S., Soil Microroganisms and Plant Growth, Oxford and IBH Publishing Company, NewDelhi.
12. Steward W.D.P., Nitrogen Fixation in Plants, The Athlone Press, London.
13. Suggestive digital platforms web links-
    - https://www.classcentral.com/tag/microbiology
    - https://www.mooc-list.com/tags/biotechnology
    - https://asm.org/articles/2020/december/virtual-resources-to-teach-microbiology-techniques
    - https://www.futuredirections.org.au/publication/living-soils-role-microorganisms-soil-health
    - https://collegelearners.com/ebooks/agricultural-microbiology-pdf-free-download

Suggested Continuous Evaluation Methods:

Total marks: 25

One Test/Assignments(hand written or typed 500 -1500 words)/Quizzes/ Presentationetc.(as decided by the teacher)carrying Maximum Marks 20 and a Viva-Voce/Class interaction of 5 marks.

24/3/22

Programme/Class: Certificate	Year:First	Semester: Second
Subject:MICROBIOLOGY		
Course Code: MBB202P	Course Title: Experiments in Agriculture and Environmental Microbiology	

Course Outcomes:

The student at the completion of the course will be able to:

- To understand the instruments, microbial techniques and good lab practices for working in amicrobiology laboratory.
- Practical skill in the laboratory experiments in microbiology.
- Develop skills for identifying microbes and using them for industrial, agricultural and environmentalpurpose.
- To prepare slides and stain to see the microbial cell.

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): L-T-P:0-0-2

S.No.	Suggested Lab /Virtual Experiment	Total No. of Lectures/ Hours (60)
1	• To analyse soil-pH, moisture, water holding capacity.	8
2	• Isolation of microorganisms (Bacteria & Fungi) from soil sample at different temperature (28°C&45° C) • Isolation of bacteria and fungi from rhizosphere and rhizoplane. • Isolation of bacteria & fungi from air environment by exposure plate method. • Isolation of Rhizobium sp. From leguminous root nodule.	16
3	• To determine BOD of waste water sample. • Bacteriological examination of water by MPN test, presumptive coliform, confirmed coliform and completed coliform test.	12
4	• Specimen study of plant pathogens. 1. Black rust of wheat 2. White rust of crucifer 3. Leaf curl of tomato 4. Downy mildew 5. Red rot of sugarcane	10
5	Study of permanent slide and life materials • *Cladosporium* • *Helmithosporium* • *Mucor* • *Curvularia* • *Alternaria* • *Geotrichurn* • *Trichoderma* • *Rhizopus*	14

SuggestedReadings:

1. Agrios A.G. Plant Pathology, Elsevier Academic Press, New Delhi, 2006.
2. Atlas RM and Batha R (2000). Microbial Ecology: Fundamentals & Applications. 4th edition. Benjamin/Cummings Science Publishing, USA.
3. Maier RM, Pepper IL and Gerba Cp (2009). Environmental Microbiology. 2nd edition, Academic Press.
4. Subba Rao NS. (1999). Soil Microbiology, 4th edition. Oxford & IBH Publishing Co. New Delhi.
5. Virtual Lab Links-
   - https://vlab.amrita.edu/?sub=3&brch=73
   - https://www.vlab.co.in/ba-nptel-labs-biotechnology-and-biomedical-engineering
   - https://opentextbc.ca/virtualscienceresources/chapter/environmental-science/

Suggested Continuous Internal Evaluation (CIE) methods

Totalmarks: 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:Second	Semester:Third
Subject: MICROBIOLOGY		
CourseCode:MBB301T	Course Title: Basic Biochemistry and Microbial Physiology	

Course Learning Outcomes:

Upon successful completion of the course, the student:

- Will have understanding of the basic principles of thermodynamics applied to biological systems
- Will be conversant with the structures of carbohydrates, lipids, proteins and nucleic acids
- Will comprehend the basic concepts of enzyme biochemistry including enzyme kinetics, and will becomeaware of different variants of enzymes found in living cells.
- Will be acquainted with the diverse physiological groups of bacteria/archaea and microbial transportsystems.
- Will have an in-depth knowledge of patterns of bacterial growth, bacterial growth curve, calculation ofgeneration time and specific growth rate, and effect of the environment on growth.
- Will apprehend how biochemical pathways are used by bacteria for energy generation and conservationduring growth on glucose under aerobic and anaerobic conditions
- Will be familiar with the physiology of nitrogen fixation and assimilation of inorganic nitrogen by bacteriaand understand how interactions between microbes and the environment affect cellular physiology.

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**

TotalNo.ofLectures-Tutorials-Practical(inhoursperweek):**L-T-P**:4-0-0

Unit	Topics	Total No. ofLectures/ Hours(60)
I	**Overview of thermodynamics and bioenergetics** Basics of thermodynamics- First and second laws, concept of enthalpy, entropy, free energy change, standard free energy change, equilibrium constant and spontaneous reactions and coupled reactions	6
II	**Water& Carbohydrates** Structure and properties of water, Handerson Hasselbalch equation, Ionic product of water, pH and buffers. Structure & classification of carbohydrates, carbohydrates metabolism: glycolysis, fermentation, Pentose phosphate pathway (PPP), Entner Doudoroff pathway, Krebs Cycle, Electron transport chain(ETC)- Chemiosmotic hypothesis, oxidative phosphorylation and ATP generation, Gluconeogenesis	12
III	**Proteins** **Structure & Classification-** Protein structure: primary, secondary- peptide unit salient features, α helix, β sheet, β turn, tertiary and quaternary-human hemoglobin as an example. Forces involved in protein folding	6
IV	**Lipids &Nucleic acids** Structure and classification of lipids. Metabolism of lipids- Alpha and beta oxidation of lipids; Nucleic acids Structures, Double helical structure of DNA. Types of DNA: A, B, Z. Physio- chemical properties of DNA. RNA types - r RNA, mRNA, t RNA.	6

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V	**Enzymology concepts:** Concepts of holozymes, apoenzyme, cofactors, prosthetic group, coenzyme, metal cofactors. Classification of enzymes; Active site and activation energy; Lock and key hypothesis, induced fit hypothesis; enzyme kinetics;	6
VI	**Microbial nutrient up take and transport:** Microbial classification based on nutrient and energy source; Nutrient up take mechanisms-passive and facilitated diffusion; Primary and secondary active transport; Concept of uniport, symport, antiport, group translocation; Iron uptake	8
VII	**Microbial growth and effect of environmental factors on growth** Bacterial growth curve and kinetics-Generation time and specific growth rate; Di auxic growth and synchronous growth; Batch, Fedbatch and continuous cultures; Chemostat and turbidostat	8
VIII	**Stress physiology and Nitrogen metabolism** Effect of oxygen, pH, osmotic pressure, heat shock on bacteria; Microbial adaptation to Environment -Temperature, pH, Oxygen, Pressure, Salt, Water activity; Extremophiles application in industry; Dissimilatory nitrate reduction, Nitrogen fixation	8

Suggested Readings:

1. Moat A.G., Foster J.W. and Spector M.P. 2002. *Microbial Physiology*, 4th edition. A Johan Wiley and sonsinc., publication.
2. Kim B.H. and Gadd G.M. 2008. *Bacterial physiology and metabolism*. Cambridge University Press,Cambridge.
3. Gilbert H.F. 2000. *Basic concepts in biochemistry: A student's survival guide*. Second Edition. Mc-Graw-Hill Companies, health professions Division, New York.
4. Madigan M.T., Martinko J.M., Stahl D.A. and Calrk D.P. 2012. *Brock Biology of Microorganisms*. 13th ed.Pearson Education Inc.
5. Jeremy M. Berg, John L. Tymoczko, Gregory J. Gatto Jr., Lubert Stryer.2015. Biochemistry 8th edition. W. H. Freeman.
6. Suggestive digital platforms web links-
   - https://lipidnanostructuresgroup.weebly.com
   - https://www.labster.com/microbiology-virtual-labs
   - https://www.microbiologybook.org
   - https://www.cpe.rutgers.edu/courses/current/lf0401wa.html
   - https://www.sciencedirect.com/topics/earth-and-planetary-sciences/microscopy
   - https://www.futurelearn.com/courses/introduction-to-microbiology

Suggested Continuous Evaluation Methods:

Total marks: 25

One Test/Assignments (hand written or typed 500 -1500 words)/Quizzes/ Presentationetc.(as decided by the teacher)carrying Maximum Marks 20 and a Viva-Voce/Class interaction of 5 marks.

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Programme/Class:Diploma	Year:Second	Semester:Third
Subject:MICROBIOLOGY		
CourseCode:MBB302P	Course Title: Experiment in Basic Biochemistry and Microbial Physiology	

Course Outcomes:

After completing the course, the student will be able to:

- Understand the structures of carbohydrates and their main properties, as well as conduct chemical tests todetect their presence in samples.
- Would have acquired practical knowledge of biochemical techniques for proteins and will be familiar withthe use of a spectrophotometer.
- Understand the fundamental principles of enzyme biochemistry, including enzyme kinetics, at the end of the course.
- Will have a thorough understanding of bacterial growth patterns, bacterial growth curves, generation timeand basic growth rate calculations, and the impact of the environment on growth.
- Will learn about the fermentation process in microbes.

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): **L-T-P:**0-0-2

S.No.	Suggested Lab /Virtual Experiment	Total No. of Lectures/ Hours (60)
1	Use and calibration of pH meter and preparation of buffers. Preparation of stock and working solutions. Handling of pipettes and micropipettes and checking their Accuracy.	4
2	**Qualitative tests** Carbohydrates: Molisch's Test, Fehling's Test, Benedict's Test, Iodine Test) Aminoacids and Proteins: Ninhydrin test, Biuret test, Lowry test. Lipids: Solubility Test, Translucent Spot Test, Emulsification Test.	20
3	Quantitative estimation of carbohydrate by anthrone method. Quantitative estimation of proteins by Lowry's method Determination of the acid value of a fat	10
4	Amylase production, H_2S production, Urease production test, IMViC test	10
5	Effect of temperature and pH on growth of E.coli, Effect of carbon and nitrogen on microbial growth.	8
6	Demonstration of carbohydrate fermentation, indole production, catalase test, oxidase test.	8

Suggested readings:

1. Daniel M. Bollag, Stuart J. Edelstein, Protein Methods, Volume 1, 1991, Wiley.
2. S. K. Sawhney, Randhir Singh,Introductory Practical Biochemistry, 2000, Narosa.
3. Sambrook J and Russell DW., Molecular Cloning: A Laboratory Manual. 4th Edition, 2004, Cold Spring Harbour Laboratory press.
4. Maloy SR, Cronan JE and Friefelder D, Microbial Genetics 2nd EDITION., 2004, Jones and Barlett Publishers
5. Larry Snyder. Molecular Genetics of Bacteria: 3rd (third) Edition.
6. Digital links
    - http://www.mooc.list.com/tag/molecular-biology
    - http://www.mooc.list.com/course/microbiology.sayloro
    - https://lipidnanostructuresgroup.weely.com
    - http://www.mooc.list.com/microbial
    - https://open.umn.edu/opentextbooks/textbooks/biochemistry-free-for-all-ahern

Suggested Continuous Internal Evaluation (CIE) methods

Totalmarks: 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.

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Programme / Class:Diploma	Year:Second	Semester:Fourth
Subject: MICROBIOLOGY		
CourseCode:MBB401T	**Course Title: Molecular Biology and Microbial Genetics**	

Course Outcomes:

At the end of the course, the student will be able to:

- Distinguish in prokaryotic cellular structure and functional components of cells, as well as the dissimilaritiesin genome organization between prokaryotes and eukaryotes.
- Describe the replication, transmission, and action mechanisms of chromosomal and extrachromosomal genesand sequences.
- Recognize and distinguish genetic regulatory mechanisms at various levels
- Gain an understanding of how internal and external signals regulate gene expression, influence microbialdiversity, and shape microbial communities and their environments.
- Describe the processes that lead to mutations and other genetic changes.

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):**L-T-P:4-0-0**

Unit	Topics	Total No. ofLectures/Hours (60)
I	**Overview of the genome organization–** DNA /and RNA as genetic material, DNA double helix structure salient features, types of DNA. RNA Structure. Denaturation and renaturation, cotcurves. DNA topology: linking number, topoisomerases. DNA organization in prokaryotes, viruses, eukaryotes.	6
II	**DNA Replication in Prokaryotes and Eukaryotes-** Bidirectional and unidirectional replication, semi-conservative and semi-discontinuous replication. Mechanism of DNA replication, Replication of chromosome ends.	6
III	**Transcription in Prokaryotes and Eukaryotes** Concept of transcription unit. General transcription process in prokaryotes and eukaryotes; Post-Transcriptional modification in eukaryotes.	8
IV	**Translation in prokaryotes and eukaryotes** Ribosome structure, t RNA structure and processing, Mechanisms of translation in both prokaryotes and eukaryotes, Genetic code, Wobble hypothesis, Fidelity Of translation	8
V	**Regulation of gene expression in prokaryotes and eukaryotes** Overview of regulation of gene expression, Regulation of gene expression by DNA methylation, histone acetylation and histone methylation mechanisms; Transcription control mechanisms, Inducible Operon System, Repressible Operon System, Translation control mechanisms.	10
VI	**Plasmids in prokaryotes and eukaryotes** Plasmid replication and partitioning, host range, plasmid incompatibility, plasmid amplification, regulation of plasmid copy number, curing of plasmids.Typesof plasmids.	6

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VII	**Bacterial gene exchange processes-** Mechanisms of Genetic Exchange, Horizontal gene transfer, Transformation; Conjugation;Transduction,Complementation.	8
VIII	**Mutations, mutagenesis and repair** Types of mutations, Physical and chemical mutagens. Loss and gain of function mutants. Reversion and suppression, Uses of mutations. Ames Test, DNA repair mechanism	8

Suggested Readings:

1. Watson, J. et. Al. 2004. Molecular Biology of the Gene,5th Edition, CSHL Press, New York.
2. Conn, E., & Stumpf, P. 2009.Outlines of Biochemistry, 5Th Ed. Wiley India Pvt. Limited.
3. T A Brown.2001. Essential Molecular Biology. Oxford University Press, USA
4. Brock, T.D. 1990. The Emergence of Bacterial Genetics, Cold Spring Harbor Lab Press.
5. Ptashne, M. 2002. Genes and Signals, Cold Spring Harbor Laboratory Press.
6. Miller, J.R. 1992. A Short Course in Bacterial Genetics: Lab Manual, Cold Spring Harbor Laboratory Press
7. Suggestive digital platforms web links-
   - https://www.classcentral.com/tag/microbiology
   - http://www.mooc.list.com/tag/molecular-biology
   - http://www.mooc.list.com/course/microbiology.sayloro
   - https://lipidnanostructuresgroup.weely.com
   - http://www.mooc.list.com/microbial
   - https://open.umn.edu/opentextbooks/textbooks/biochemistry-free-for-all-ahern

Suggested Continuous Evaluation Methods:

Total marks: 25

One Test/Assignments (hand written or typed 500 -1500 words)/Quizzes/ Presentationetc.(as decided by the teacher)carrying Maximum Marks 20 and a Viva-Voce/Class interaction of 5 marks.

Programme/Class: Diploma	Year:Second	Semester:Fourth
Subject:MICROBIOLOGY		
CourseCode: MBB402P	Course Title: Experiment in Molecular Biology and Microbial Genetics	

Course Outcomes:

The student at the completion of the course be able to:

- Understand the fundamentals of molecular biology and genetic research.
- Use some basic equipment in a molecular biology laboratory.
- Extract genomic DNA from microbes using molecular biology techniques
- Measure DNA and verify purity using UV spectrometer and electrophoresis.
- Understand the basic principle of plasmid isolation and their conformations using electrophoresis.
- Understand the mutagenic effect of chemical and physical agents and perform test to identify mutageniceffect of chemicals

Credits:2	Core:Compulsory
Max.Marks **CIE:25** Max.Marks **End Semester Examination:75** **Total Max. Marks: 100**	Min.PassingMarks **CIE:09** Min.Passing Marks **End Semester Examination: 26** **Total Min. Passing Marks: 35**

Total No. of Lectures-Tutorials-Practical (in hours per week) : **L-T-P: 0-0-2**

S.No.	Suggested Lab /Virtual Experiment	Total No. of Lectures/Hours (60)
1	Isolation of genomic DNA from *E. coli* and analysis by agarose gel electrophoresis.	8
2	Estimation of DNA using diphenylamine reagent.	8
3	Resolution of proteins by polyacrylamide gel electrophoresis(SDS-PAGE)and visualization using coomassie dye.	10
4	Replica plating method: Preparation of master and replica plates. Isolation of Histidine auxotrophs	10
5	Isolation of plasmid DNA from *E.coli.* Study the different conformations of Plasmid DNA through agarose gel electrophoresis	8
6	Study of the effect of chemical (nitrous acid) and physical (UV) mutagens on Bacterial cells.	8
7	Demonstration of Ames test.	8

Suggested readings:

1. Michael Wink, An Introduction to Molecular Biotechnology (2nd), 2012. ISBN: 9783527326372, TXWiley-Blackwell.
2. Seidman & Moore, Basic Laboratory Methods for Biotechnology: Textbook & Laboratory Reference,2nd edition. 2009. Prentice Hall. ISBN: 0321570146.
3. Sambrook J and Russell DW., Molecular Cloning: A Laboratory Manual. 4th Edition, 2004, Cold SpringHarbour Laboratory press.
4. Digital links:
   - https://www.sciencedirect.com/topics/pharmacology-toxicology-and-pharmaceutical-science/ames- test
   - https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4846332/

Suggested Continuous Internal Evaluation(CIE)methods

Totalmarks: 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.

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Programme/ Class: Degree	Year:Third	Semester:Fifth
Subject:Microbiology		
CourseCode:MBB501T	Course Title: Medical Microbiology	

Course outcomes:

Upon completion the students will learn:

- The historical development of medical microbiology
- The importance of microorganisms in life.
- The microorganisms associated with various infectious diseases.
- The treatment strategies followed for the infectious diseases.
- Antibiotic resistance
- Processes of sample collection and processing

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): **L-T-P: 4-0-0**

Unit	Topics	Total No. of Lectures/ Hours (60)
I	**History of Medical Microbiology** Contribution of pioneers in the field of Medical Microbiology, Normal Microflora of human body: skin, mouth, alimentary canal and gintourinary tract	7
II	**Bacterial diseases** Diseases caused by certain bacterial pathogens *Staphylococcus aureus, Streptococcus pneumoniae, Mycobacterium tuberculosis, Salmonella typhi, Vibrio cholera*	8
III	**Viral diseases** Diseases caused by certain viruses Human Immunodeficiency Virus, Hepatitis Virus, Influenza virus, Herpes virus	8
IV	**Parasitic diseases** Diseases caused by protozoa *Giardia* sp., *Plasmodium* sp., *Leshmania* sp.,and *Entamoeba* sp.	7
V	**Pathogenic fungal disease I** Dermatophytes - *Trichophyton, Microsporum* Filamentous fungi causing subcutaneous infection by Mucor, *Rhizopus* and *Aspergillus*	8
VI	**Pathogenic fungal disease II** Systemic mycoses caused by Blastomyces, Histoplasma and Yeast like fungi: *Candida* and *Cryptococci*	8
VII	**Antibiotics and Chemotherapeutics** Historical development of chemotherapeutic and antibiotic substances, Major Antimicrobial agents, Mode of action of chemotherapeutic and antibiotic substances.	8
VIII	**Antibiotic resistance, Sample collection and processing** Drug resistance, Mechanism of antibiotic resistance, Antibiotic susceptibility assay. Collection and transport of appropriate clinical sample specimen for clinical diagnostics	6

Suggested Readings:

1. Annadurai, A. A textbook of Immunology and Immunotechnology. S. Chnd
2. Ananthanarayanan R and Panicker C K. Textbook of Microbiology. Orient Longman.
3. Baveja, CP. Text book of Microbiology. Arya publications.
4. Ken S. Rosenthal, Patrick R. Murray, and Michael A. Pfaller. Medical Microbiology 7th Edition, Elsevier
5. Karen C.Carroll, Geo.Brooks, Stephen Morse, and Janet Butel. Jawetz, Melinck, &Adelberg's Medical Microbiology, Lang
6. Suggestive digital platforms web links-
   https://www.futurelearn.com/courses/basic-concepts-in-microbiology-and-clinical-pharmacology-of- antimicrobials
   https://vlab.amrita.edu/?sub=3&rch=73
   https://www.mooc-list.co/tags/pathology
   https://online.creighton.ed/program/medical-microbioogy-and-immunology-ms

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.

2/5/22

Programme/ Class: Degree	Year:Third	Semester:Fifth
Subject:Microbiology		
CourseCode:MBB502T	Course Title: Immunology	

Course outcomes:
Upon completion the students will learn
- The historical development of immunology
- The components of immune system, Immune responses, features of antigen and antibody,hypersensitivity responses
- Applications of antibody in diagnosis and therapy, and antigen-antibody reactions.

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**

TotalNo.ofLectures-Tutorials-Practical(inhoursperweek):**L-T-P:4-0-0**

Unit	Topics	TotalNo.of Lecture s/Hours (60)
I	**Over view of Immunology** History of immunology, Physical and physiological barriers, Innate and Acquired immunity, Organs and Cells of Immune system.	7
II	**ComplementSystem** Complement System Proteins, Complement System Activation by Classical, Alternate and Lectin Pathway	8
III	**Immunity** Humoral and Cell Mediated Immunity, Active And Passive Immunity	8
IV	**Antigen & Immunogens** Antigen Characteristics, Types of Antigens, Adjuvants, Immunogenicity and Antigenicity, Cytokines,	7
V	**Immunoglobulins and MHC and their role** Classes of immunoglobulin, structure and function, Major Histocompatibility Complex: Types, Antigen Presentation through MHC class I and class II molecules	9
VI	**Hypersensitivity** Types of Hypersensitivity, Mechanism of hypersensitivities withexamples	5
VII	**ImmuneResponse** Antibody dependent Cell mediated Cytotoxicity, Phagocytosis, Inflammation and Inflammatory response mechanism.	6
VIII	**Applications of Immunoglobulins** Applications of antibody in diagnosis and therapy; *Invitro* serological testmethods: Antigen-Antibody Reactions: Agglutination and immune diffusion; ELISA and RIA.	10

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Suggested Readings:

1. Kindt, Goldsby and Osborne. Kuby's Immunology. WH Freeman& Company,
2. Roitt I,Brostoff, J and Male D.Immunology, 6th edition, 2001, Mosby, London.
3. Ramesh SR, Immunology. Mc Graw Hill Publications.
4. Madhavee LP, A Textbook of Immunology, S Chand Publisher.
5. Reddy R, Textbook of Immunology, 3rd edition, AITBS Publisher.
6. Digital links
    - https://www.mcgill.ca/microimm/undergraduate-programs/courses
    - https://oline.creighton.edu/program/medical-microbiology-and-immunology-ms

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:Third	Semester:Fifth
Subject: Microbiology		
CourseCode:MBB503P	Course Title: Experiments in Medical Microbiology & Immunology	

Course outcomes:

Upon completion of the practical course in medical microbiology and immunology the students will learn about

- The preparation of culture media, microorganisms associated with human body, characterization of microorganisms associated with disease.
- Antigen- antibody interaction
- Learning of the application of antibodies for diagnostic purposes, antibiotic sensitivity test and resistance transfer.

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): **L-T-P: 0-0-2**

S.No.	Suggested Lab /Virtual Experiment	TotalNo.of Lectures/Hours(60)
1	Preparation of blood agar, chocolate agar, and other media required for medically Important microorganisms	6
2	Isolation and characterization of skin normal microflora	6
3	Isolation of bacteria from teeth crevices	6
4	Demonstration of α and β haemolysis on blood agar medium.	8
5	Demonstration of serological tests: blood groups, Rh factor determination, pregnancy test, Widal, VDRL, ELISA	12
6	Demonstration of pathogenic fungi in mycoses lesion	8
7	Antibiotic sensitivity test and MIC determination	6
8	Demonstration of antibiotic resistance transfer from resistant to sensitive microorganism	8

Suggested Readings:

1. Hudson L, and Hay FC, Practical Immunology, 3rd edition, Wiley.
2. Noel R. Rose, Herman Friedman, John L. Fahey., Manual of Clinical Laboratory Immunology, 3rd edition,ASM. Ed.3; 1986.
3. Talwar GP and Gupta SK, A Handbook of Practical and Clinical Immunology, Vol.I-II; CBS Publishers and Distributors. Delhi
4. Aneja KR, Experiments in Microbiology, Plant Pathology and Biotechnology, 1st edition, New Age International Publisher
5. Randhawa VS, Practicals and Viva in Medical Microbiology, Harcourt India Pvt. Ltd.
6. Digital Links
    - http://www.vlab.co.in
    - http://www.vlab.iitb.ac.in
    - http://www.onlinelabs.in
    - http://www.vlab.amrita.edu
    - http://asm.org/articles/2020/december/virtual-resources-to-teach-microiology-techniques

Suggested Continuous Internal Evaluation (CIE) methods

Totalmarks: 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.

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Programme/Class: Degree	Year:Third	Semester: Sixth
Subject:Microbiology		
CourseCode:MBB601T	Course Title: Food Microbiology	

Course outcomes:

- Upon completion the students will learn about the role of Microorganism in food Microbiology.
- Learn the symptoms of deteriorated food.
- Assimilate knowledge about Microbial Examination of food.
- Learn about food preservation techniques.
- Will get sufficient knowledge regarding analysis of milk.
- Will be able to monitor food quality.

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): **L-T-P: 4-0-0**

Unit	Topics	TotalNo.ofLectures/Hours(60)
I	**Introduction to food & nutrition.** History, Development and Scope of food microbiology; Concept of food and nutrients; Physiochemical properties of food; Importance and types of Microorganisms in food (bacteria, mold and yeast);Food as a substrate for microorganism-Intrinsic and extrinsic factors that affect growth and survival of Microbes in food, natural flora and source of contamination of foods in general.	8
II	**Microbial spoilage of various foods** Principal; Spoilage of vegetables, fruits, meats, eggs, milk and butter, bread, canned foods.	6
III	**Microbial examination of food** DMC, viable count, examination of fecal coliforms . Food quality monitoring, Biosensors and Immunoassays.	6
IV	**Food Preservation** Basic Principles, Methods (heating, freezing, dehydration, chemical preservatives, radiation). Modern technologies in food preservation, Packaging material.	8
V	**Fermented foods:** Fermented dairy products (cheese, butter, yoghurt, Kefir). Other Fermented foods- Soya sauce, Saurkraut, Dosa. Probiotics: health benefits, types of microorganisms used, probiotic foods available in market.	8
VI	**Food borne diseases (Causative agents, foods involved, symptoms and preventive measures)** Food intoxication- Staphylococcus aureus, Clostridium botulinumand Mycotoxins; Food infections- *E.coli, Salmonellosis, Bacilluscereus, Sheigellosis, Listeria.*	8

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VII	**Microorganisms and milk** Physical and chemical properties of milk; Milk as a substrate for microorganisms; Microbiological analysis of milk–Rapid Platform test, standard plate count, MBRT test, alkaline phosphatase enzyme test, DMC; Method of preservation of milk and milk product, pasteurization, sterilization and dehydration.	8
VIII	**Food sanitization and control** HACCP, Indices of food sanitary quality and sanitisers; Microbiological quality standard of food.	8

Suggested Readings:

1. Adams & Moss, Food Microbiology, Published by Royal Society of Chemistry, Cambridge, U.K.
2. R.S. Mehrotra – Plant Pathology, Tata Mc-Graw Hill
3. Frazier & Westhoff., Food Microbiology Tata Mc-Graw Hill (2014)
4. Varnam A.H. & Evans M G – Food borne pathogens. Wolfe Publishing House, London
5. B.D. Singh (2015) Biotechnology. Kalyani Publisher
6. Prajapati (2007) Fundamentals of Dairy microbiology, Indian Council of Agricultural Research, NewDelhi
7. Andrew Proctor (2011) Alternatives to conventional food processing. RSC Publisher
8. Arun K. Bhunia & Bibek Ray, Fundamental Food Microbiology, 5th Ed., CRC Press

Suggestive digital platforms web links –

- Doyle. Michael P, Gonzalez-francisco Diez, Food Microbiology : Fundamentals and frontiers, 5th edition, Hill Colin, available on Wiley online Library.
- http://www.vlab.co.in
- http://www.vlab.amrita.edu
- http://asm.org/articles/2020/december/virtual-resources-to-teach-microiology-techniques

SuggestedContinuousEvaluationMethods:

Totalmarks: 25

One Test/Assignments(hand written or typed 500 -1500 words)/Quizzes/ Presentationetc.(as decided by the teacher)carrying Maximum Marks 20 and a Viva-Voce/Class interaction of 5 marks.

2-15-22

Programme/Class: Bachelor of Science	Year:Third	Semester: Sixth
Subject: Microbiology		
CourseCode:MBB602T	Course Title: Industrial Microbiology	

Course outcomes :

- Develop understanding about IPR in industry
- Understand role of microorganism in industry
- Know about Processing & selection of best microbial strains for the industry
- Gain fundamental knowledge of fermentation process
- Gain knowledge about production of various pharmaceutical products or industrially important product

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): **L-T-P: 4-0-0**

Unit	Topics	Total No. of Lectures/Hours (60)
I	History & Multidisciplinary nature of Industrial microbiology. A typical Bioprocess: Introduction, advantages & limitations. Patents and intellectual propertyrights.	7
II	Taxonomic diversity of industrially useful bacteria &fungi. Important characteristics of microbes used in Industrial Microbiology, Isolation techniques. Concept & examples of microorganisms classified as Generally Regarded as Safe (GRAS).	8
III	Exploitation of microorganism and their products, Screening, Strain development strategies, Immobilization methods.	8
IV	Fermentation: Media, Raw material, Antifoaming agents, Buffers. Equipments, Fermenter design. Types of fermentation–Single, Batch, Continuous.	7
V	Down-stream processing steps: Detection and assay of the product. Recovery (inter cellular and extra cellular product). Purification (solvent extraction & chromatography)	9
VI	Production of Alcohol (industrial alcohol, wine, beer, whiskey), Organic acid (Citric acid), Antibiotic (Penicillin)	7
VII	Production of Vitamin (B12),Enzyme (Amylase), Amino acid (Glutamic acid),Hormones (Insulin), Vaccine (Hepatitis B).	6
VIII	Biofuel (Methane), Production of Biofertilizers & Biopesticides, Biotransformation of steroids.	8

Suggested Readings:

1. Industrial Microbiology (2000) by AH Patel, Macmillan Publishers India
2. Biology of Industrial microorganism (1981) by Arnold L. Domain, Bejamin/ cummings Pub. Co.
3. Industrial Microbiology by Prescott & Dunns, AVI Publishing Company Inc.
4. Industrial Microbiology by Casida LE, New age International (P) Ltd.

Suggestive digital platforms web links

- http://foodhaccp.com/foodsafetymicro/onlineindex.html
- http://www.cpe.rutgers.ed/courses/current/lf0401wa.html

Suggested Continuous Evaluation Methods:

Total marks: 25

One Test/Assignments (hand written or typed 500 -1500 words)/Quizzes/ Presentationetc.(as decided by the teacher) carrying Maximum Marks 20 and a Viva-Voce/Class interaction of 5 marks.

20/5/22

Programme/Class: Degree	Year:Third	Semester:Sixth
Subject: Microbiology		
Course Code: MBB603P	Course Title: Experiments in Food & Industrial Microbiology	

Course outcomes:

- Understand the instruments, techniques & Lab discipline
- Develop skill for identifying microbes used in industry
- Upon completion student will learn about the process of fermentation & design of bioreactors, a majorpart of pharmaceutical industry
- Will learn about the culture of microorganisms used in Food & Industrial microbiology.

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): **L-T-P: 0-0-2**

S.No.	Suggested Lab /Virtual Experiment	TotalNo.ofLectures/Hours(60)
1	Study of Bioreactor & its essential parts	4
2	Necessity & procedure of writing SOPs for instruments used in large scale production	6
3	Isolation and microscopic observation of industrially important microorganism	8
4	Isolation and characterization of microorganism used in Dairyindustry	8
5	Isolation and characterization of Yeast used in Bakery/distillery/winery	8
6	Isolation & identification of important microorganism of food microbiology	8
7	Bacteriological analysis of food products	8
8	Determination of the quality of milk by MBRT	2
9	Bacterial examination of milk–Alcohol test	4
10	Preservation methods	4

Suggested Readings:

1. Aneja, K.R. 1993. Experiments in Microbiology, Pathology and Tissue Culture, Vishwa Prakashan, NewDelhi.
2. Dubey, R.C. and Maheshwari. D.K. 2012. Practical Microbiology, S.Chand & Company, Pvt. Ltd., NewDelhi. Pandey. B.P. 2014 Modern Practical Botany, (Vol-I) S. Chand and Company Pvt. Ltd., New Delhi.
3. W.F. Harrigan, Laboratory methods in Microbiology, Publisher – Elsevier
4. Lynne Mc Landsborough, Food Microbiology Laboratory, CRC Press
5. Brain McNeil & Harvey (2008), Practical Fermentation Technology, John Wiley & Sons Ltd.
6. Digital links
   a. http://www.vlab.co.in
   b. http://www.vlab.iitb.ac.in
   c. http://www.onlinelabs.in
   d. http://www.vlab.amrita.edu
   e. http://asm.org/articles/2020/december/virtual-resources-to-teach-microiology-techniques
   f. http://foodhaccp.com/foodsafetymicro/onlineindex.html
7. http://www.cpe.rutgers.ed/courses/current/lf0401wa.html

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.

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

BACHELOR OF COMPUTER APPLICATION (B.C.A.)
DETAILED SYLLABUS
FIRST SEMESTER

S.No.	Name of the Course	Course Code	Course Content	Course Objective
1	Computer Fundamental and MS - Office	C-101	**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, and 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.	CO1: To impart knowledge about the structure, components and functions of a computer system, different categories based on their capabilities and the Binary number system
			UNIT-II **Algorithm and Flowcharts Algorithm**: Definition, Characteristics, Advantages and disadvantages, Examples Flowchart: Definition, Define symbols of flowchart, Advantages and disadvantages, Examples	CO2: Understanding of the importance of algorithms in the development of computer applications and design of algorithm and flowchart

			UNIT-III Operating System and Services in O.S., DOS, History, Files and Directories, Internal and External Commands, Batch Files, Types of O.S.	CO3: Familiarization with the terms like Operating System, peripheral devices, networking, multimedia, internet, etc.
			UNIT-IV Windows Operating Environment Features of MS-Windows, Control Panel, Taskbar, Desktop, Windows Application, Icons, Windows Accessories, Notepad, Paintbrush.	CO4: Learn the basics of operating windows and its features and how they can be used to make your academic work more efficient.
			UNIT-V Editors and Word Processors Basic Concepts, Examples: MS-Word, Introduction to desktop publishing. Spreadsheets and Database packages Purpose, usage, command, MS-Excel, Creation of files in MS-Access, Switching between application, MS-PowerPoint.	CO5: Learn basic word processing skills with Microsoft Word, Develop the skill to work with MS-Word, Excel , MS- Access and PowerPoint.
Suggested Books: 1. Fundamental of Computers,By V.Rajaraman B.P.B. Publications 2. Fundamental of Computers,By P.K. Sinha 3. MS-Office 2000(For Windows),By Steve Sagman 4. Computer Networks,By TennenbumTata MacGraw Hill Publication				
2.	Introduction to Programming using C	**C-102**	**UNIT-I** **C basics**: C character set, Identifiers and keywords, Data types, constants, variables and arrays, declarations, expressions statements, symbolic constants, compound statements ,arithmetic operators, unary operators, relational and logical	CO1: To learn advance structured and procedural programming and to improve C programming skills, the basic structure of a C program, role of variable, operators and keywords in programming.

			operators, assignment operators, conditional operators, bit operators.	
			UNIT-II **Decision Control Structures:** If Statement, If-else statement, Nested if (), If () ladder, Switch, case statement, Iterative statements: For loop, While loop, Do-while() loop, Conditional statements: Break, Continue, Storage Classes, Array: Declaration of an Array, Initialization of Array, Types of Array: Single Dimension Array, Two-Dimensional Array, Address Calculation of an Element of a 2-D Array	CO2: Learn and understand the working of conditional and looping statements and concept and importance of array in programming.
			UNIT-III **Functions:** Library Functions, User Defined Functions, Function Declaration, Prototype Declaration, Types of Arguments: Actual Arguments, Formal Arguments, Function Definition, Passing Arrays as Parameters, Methods to Call a Function: Call by Value, Call by Reference.	CO3: Understanding the working of function in code organization.
			UNIT-IV **Pointers:** Declaration of Pointer Variables, Pointer Arithmetic, Returning Multiple Output Values through a Function Strings.	CO4: Ability to design and develop Computer programs, analyzes, and interprets the concept of pointers, declarations, initialization, operations on pointers and their usage.
			UNIT-V Structures, Unions, Array of Structures, Enumerations, File Handling: Opening a File, Closing a File, File, Opening Modes, Reading from and Writing	CO5: Know the concept file handling, input output operations. Able to use the structure and union.

			to a File, Copying Content of an Existing File to another, Command Line Arguments, argc and argv Parameters, Pre-processor Directives.	
Suggested Books: 1. E.Balagurusamy, “Programming in ANSI C”, TMH 2. PeterNorton’s, “Introduction to Computers”, TMH 3. YashwantKanetkar, “Let us C”, BPB				
3.	Business Communication and Soft Skills	C-103	**UNIT-I** **Means of Communication**: Meaning and Definition, Process, Functions, Objectives, Importance, Essentials of good communication, Communication barriers, 7C’s of Communication, Types of Communication: Meaning, nature and scope.	CO1: Learn the importance of communication, its need & benefits and forms of communication.
			UNIT-II **Oral communication**: 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. **Written Communication** Purpose of writing, Clarity in Writing, Principle of Effective writing, Writing Techniques, Electronic Writing Process. **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.	CO2: Mastering the art of Formal correspondence writing, To actively participate in oral and written communication in practical applications.

			UNIT-III **Drafting of business letters:** Enquiries and replies, Placing and fulfilling orders, Complaints and follow, up Sales letters, Circular letters Application for employment and resume. **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. **Self Analysis:** SWOT Analysis, Who am I, Attributes, Importance of Self Confidence, Self Esteem. Creativity: Out of box thinking, Lateral Thinking**.**	CO3: To study the development of skills of comprehension writing letters, and understand the use of information technology in communication.
			UNIT-IV **Attitude:** Factors influencing Attitude, Challenges and lessons from Attitude, Etiquette. Motivation: Factors of motivation, Self talk, Intrinsic & Extrinsic Motivators. Goal Setting: Wish List, SMART Goals, Blue print for success, Short Term, Long Term, Life Time Goals. **Interpersonal Skills:** Gratitude: Understanding the relationship between Leadership Networking & Team work. Assessing Interpersonal Skills Situation description of Interpersonal Skill. Team Work: Necessity of Team Work Personally, Socially and Educationally.	CO4: Learn about the interpersonal skills and how the attitude plays a positive role in communication and how to motivate our self and work as motivator for others.
			UNIT-V **Leadership:** Skills for a good Leader, Assessment of Leadership Skills, Stress Management: Causes of Stress and its impact, how to manage & distress, Circle of control, Stress Busters. Emotional	CO5: Learn how to become a good leader with leadership skills and decision making and how to handle emotional challenges.

			Intelligence: What is Emotional Intelligence, emotional quotient why Emotional Intelligence matters, Emotion Scales, Managing Emotions. **Conflict Resolution:** Conflicts in Human Relations – Reasons Case Studies, Approaches to conflict resolution. Decision Making: Importance and necessity of Decision Making, Process and practical way of Decision Making, Weighing Positives & Negatives.	

Suggested 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.	Introduction to HTML, CSS- XML	C- 104	**UNIT-I** Basics of Internet and Web The basics of Internet, World Wide Web, Web page, Home page, Web site, Static, Dynamic and Active web page, Overview of Protocols, Simple Mail Transfer Protocol, Gopher, Telnet,Emails,TFTP,Simple Network Management Protocol, Hyper Text Transfer Protocol,Client server computing concepts.Web Client and Web Sever Web Browser, Browsers e.g.,Netscape navigator,Internet Explorer,Mozilla Firefox,Client,Side Scripting Languages,VB Script and Java Script, Active X control and Plug-ins,Web Server Architecture, Image maps,CGI,API web database connectivity,DBC,ODBC	CO1: To learn the basic knowledge of softwrae use in website development, improve the visual design and content structuring.
			UNIT-II Dynamic HTML, Document Object Model, Features of DHTML, CSSP (Cascading Style Sheet Positioning) and JSSS (JavaScript assisted Style Sheet), Layers of Netscape, The ID Attribute, DHTML Events	CO2: Learn the basics of HTML , DHTML programming and importance of CSS.
			UNIT-III **Introduction to HTML:** Editors, Basics, Element,	CO3: Understanding the use of HTML tags, Designing

<table>
<tr><td></td><td></td><td></td><td>Attribute, Headings, Paragraphs, Styles, Formatting, Quotations,Comments,CSS,Links,Images,Tables,Lists, Blocks,Classes,ID, frames, File Paths, Head, Layout, Computer Code, Entities, Symbols, Charset, Colorand Background of Web Pages, Hypertext, Hyperlink and Hypermedia, Links, Anchors and URLs, Links to External Documents, Different Section of a Page and Graphics, Footnote and E-Mailing, Creating Table, Frame, Form and Style Sheet.</td><td>and Developing web pages using HTML, Create Format cells, rows, columns, and entire worksheets.</td></tr>
<tr><td></td><td></td><td></td><td>UNIT-IV
CSS: Introduction, Syntax, Colors, Backgrounds, Borders, Margins, Padding, Height/ Width, Box Model, Outline, Text, Fonts, Icons, Links, Lists, Tables, Display, Max, Width, Position, Overflow, Float, Inline, Block, Align, Combinators,Pseudo,Class,Pseudo Elements, Opacity, Navigation Bar, Dropdowns, Image Gallery, Image Sprites, Attr Selectors, Forms, Counters, Website Layout, Units,Specificity.</td><td>Learn the basic of styling web page using CSS.</td></tr>
<tr><td></td><td></td><td></td><td>UNIT-V
XML: Introduction, Tree, Syntax, Elements, Attributes, Namespaces, Display, HTTP request, Parser, DOM, XPath, XSLT,XQuerry,XLink, Validator, DTD, Schema, Server</td><td>Learn and understand how the XML supports information exchange between computer systems such as websites, databases, and third-party applications.</td></tr>
<tr><td colspan="5">Suggested Books:
1. Shelley Powers, “Dynamic Web Publishing” 2
2. Html & CSS: The Complete Reference 5th Edition (English, Paperback, Thomas A. Powell)
3. XML: The Complete Reference Book by Heather Williamson</td></tr>
<tr><td>5.</td><td>Mathematics -I</td><td>C-105</td><td>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</td><td>CO1:
Learn the uses of matrices and determinants to solve a system of simultaneous linear equations.</td></tr>
</table>

			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	CO2: Learn how a function of two variables can approach different values at a boundary point, depending on the path of approach.
			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,CurveTracing,Successive Differentiation & Liebnitz Theorem.	CO3: Learn how the Differentiation is used to study the small change of a quantity with respect to unit change of another.
			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).	CO4: Learn how the integration is used to add small and discrete data, which cannot be added singularly and representing in a single value.
			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.	Understand how the vector algebra perform algebraic operations on vectors and vector spaces.

Suggested 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.				

BACHELOR OF COMPUTER APPLICATION (B.C.A.)
DETAILED SYLLABUS
SECOND SEMESTER

1.	Object Oriented Programming Using C++	C- 201	**UNIT-I** **Introduction:**Introducing ObjectOriented Approach, Procedural Programming Language Vs Object Oriented Language. Basic concept of OOPs, operators, tokens, variables, Keywords, Data types, identifiers, characters,typedef statement, constants, Enumerated data type.	CO1: To give an overview of benefits of Object-Oriented Programming (OOP) approach over the Traditional Programming approaches.
			UNIT-II **Control Flow:** If statement, If Else statement, Nested If, Else, Statements, For Loop, While Loop, Do, While Loop, Break, Switch, Continue, goto. Classes and Objects,Encapsulation, information hiding, abstract data types, Object & classes, attributes, methods, C++ class declaration, Constructors and destructors, Default parameter value, object types,C++ garbage collection,dynamic memory allocation,Metaclass / abstract classes.	CO2: Learn how to analyze the concept of classes and object, array, functions, constructor and destructor and statements, and skill to write codes in C++ by applying concept of OOP.
			UNIT-III **Array:** Array Illustration, Multi, Dimensional arrays, Strings, Array of Strings, Function prototype, function return data type, parameter passing, Default argument, Inline function, Function Overloading, Array Function, Operator Overloading,	CO3: Learn uses of array in programming and the concept of function and operator overloading in OOPS.
			UNIT-IV **Pointers:** Pointer to Derived Class, array of Pointers,	CO4: Ability to design and develop Computer programs, analyzes, and interprets the concept of pointers,

			Inheritance and Polymorphism: Inheritance,Class hierarchy,derivation,public,private & protected, abstract Classes, Single, Multilevel, Multiple, Hierarchical, Hybrid, benefits of Inheritance.	declarations, initialization, operations on pointers and their usage.
			UNIT-V **Files and ExceptionHandling:** Streams and files,Namespaces,Exception handling.	CO5: Ability to isolate and learn how to handle exception using exception handling in C++programs
Suggested Books: 1. A.R.Venugopal,Rajkumar, T. Ravishanker "Mastering C++", TMH, 1997. 2.S.B.Lippman&J.Lajoie," C++ Primer",3rdEdition, Addison Wesley, 2000.The C programming Lang.,PersonEcl,Dennis Ritchie 3. R.Lafore,"Object Oriented Programming using C++",Galgotia Publications,2004 4. D.Parasons,"Object Oriented Programming using C++",BPB Publication				
2.	Digital Electronics	C-202	**UNIT-I** **Number System & Boolean Algebra:** Number System: Binary, Octal, Decimal, Hexadecimal, Conversion of Number System, Binary Arithmetic &Complement, Binary Codes: Weighted &Non Weighted, Gray Code, Excess-3 Code. Error Detection Codes, Hamming Code, Boolean Function, Boolean Postulates, De-Morgan's Theorem, Boolean Expressions: Sum of Product, Product of Sum, Minimization of Boolean Expressions using K-Map, Logic Gates: AND, OR,NOT,NAND, NOR, XOR, XNOR, Implementations of Logic Functions using Gates, NAND, NOR Implementations, Multilevel gate Implementations.	CO1: To acquire the basic knowledge of number and understanding of the fundamental concepts & techniques used in digital electronics.
			UNIT-II **Combinational Circuits:** Adders & Subtractors: Half Adder, Full Adder, Binary Adder, Half Subtractor, Full Subtractor, Magnitude Comparator: Two Bit Magnitude Comparator, Three Bit Magnitude Comparator, Multiplexer &De-Multiplexer: 4*1	CO2: The ability to understand, analyze and design various combinational circuits.

			Multiplexer, 8*1Multiplexer, Decoder & Encoder, Parity Checker &Generator, Code Converter.	
			UNIT-III **Sequential Circuit:** Introduction to Flip Flops: SR, JK, T, D, Master Slave Flip Flops, Conversion of Flip Flops, Characteristic Table & Equation, Edge Triggering & Level Triggering, Excitation Table, State Diagram, State Table, State Reduction, Design of Sequential Circuits.	CO3: The ability to understand, analyze and design various sequential circuits.
			UNIT-IV: **Registers**: Introduction of Registers, Classification of Registers, Register with Parallel Load, Shift Registers, Bidirectional Shift Register with Parallel Load.	CO4: Demonstrate the knowledge of register and learn the working of its classification.
			UNIT-V: **Counters:** Introduction of Counter, Asynchronous/Ripple Counters, Synchronous Counters, BCD Counter,4-bit Binary Counter with Parallel Load, Design of Synchronous Counters, Ring Counter, Johnson Counter.	CO5: Demonstrate the knowledge of counters and Analyse & design sequential digital circuits like counters.
Suggested 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 Lea				
3.	Data Structure Using'C'/'C++'	C-203	**UNIT-I** Classification of Data Structure, Operations on Data Structure, Address Calculation, Application of arrays, Limitation of Array, Application of Arrays, Array as Parameters, Sparse Matrices	CO1: To introduce the fundamental concept of data structures and to emphasize the importance of data structures in developing and implementing efficient algorithms.
			UNIT-II **Continuous Implementation (Stack):** Array Representation, Operations on Stacks: Push & Pop, Applications of stack, Conversion of Infix to Prefix and Postfix Expressions, Evaluation of postfix expression using stack Recursion: Recursive	CO2: Describe how stacks & queues are represented in memory and used by algorithms and understand the concept writing recursive methods.

			Definition and Processes, Principles of Recursion, Tower of Hanoi Problem, Recursion Vs. Iteration Continuous. Implementation (Queue): Array representation and implementation of Queues, Operations on Queue: Create, Add,Delete,Full and Empty Queue, Circular Queue, Dequeue and Priority Queue	
			UNIT-III **Non Continuous Implementation:** Link Lists: Linear List concept, Linked List Terminology, Representation of Linked List in Memory, Types of Linked List, Single Linked List, Doubly Linked List, Single Circular Linked list, Circular Doubly Linked List, Operations on Link List: Create List Insert node (empty list ,beginning ,middle, end),Delete node(first, general case), Traversing node, Searching node, Print list, Count Nodes, Sort Lists	CO3: Understand the concept and implementation of linked list and design an algorithms of operation performed on linked list.
			UNIT-IV: **Trees:** Introduction to Tree & its Terminology, Binary trees, Types of Binary trees, Representation of Binary Tree, Traversals (Inorder, Preorder,Postorder),Tree Expression, Binary Search Tree, Insertion and Deletion in BST.	CO4: Learn the concept of trees and solve the problem trees .
			UNIT-V: **Sorting & Searching Techniques:** Bubble Sort, Selection Sort, Insertion Sort, Quick Sort, Merge Sort, Sequential Search, Binary Search	CO5: Understand the concept of sorting and searching techniques, and learn to apply Algorithm for solving problems like sorting, searching.
Suggested Readings: 1. S. Lipschutz,“ Data structures”, Mc, Graw, Hill International Editions,1986. 2. A. Michael Berman,“Data Structures via C++”,Oxford University Press,2002. 3. M. Weiss,“Data Structures and Algorithm Analysis in C++”,Pearson Education				
4.	Principles of Management	C-204	**UNIT-I** **Nature of Management:** Meaning, Definition, it's nature purpose, importance & Functions,	CO1: Describe the primary functions and importanceof

			Management as Art, Science & Profession- Management as social System Concepts of management, Administration, Organization, Evolution of Management.	management and the roles of administration and organization.
			UNIT-II **Functions of Management:** Planning - Meaning - Need & Importance, type's levels, advantages & limitations. Forecasting - Need & Techniques Decision making – Types, Process of rational decision making & techniques of decision making Organizing.	**CO2:** ➢ Able to understand decision making process
			UNIT-III **Elements of organizing & processes:** Types of organizations, Delegation of authority - Need, difficulties in delegation - Decentralization Staffing - Meaning & Importance Direction, Nature, Principles Communication, Types & Importance Motivation, Importance, theories, Leadership - Meaning - styles, qualities & functions of leaders	**CO3:** ➢ Understanding of communication principles, Importance Motivation and Leadership - Meaning
			UNIT-IV **Functions of Management:** Controlling - Need, Nature, importance, Process & Techniques Coordination - Need – Importance, 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.	CO4: ➢ Able to understand techniques Coordination, Levels of Decision

			UNIT-V **Recent Trends in Management:** Social Responsibility of Management – environment friendly management, Management of Change Management of Crisis Total Quality Management Stress Management International Management	CO5: ➢ Explain about recent Trends in Management

Suggested Books:

1. Essential of Management - Horold Koontz and IteinzWeibrich– McGrawhills International
2. Management Theory & Practice - J.N.Chandan
3. Essential of Business Administration - K.Aswathapa Himalaya Publishing House

5.	**Numerical Methods**	**C-205**	**UNIT-I** **Roots of Equations:** Bisections Method, False Position Method, Newton's Raphson Method, Rate of convergence of Newton's method.	**CO1:** ➢ Reason mathematically about basic discrete structures such as numbers, Newton's Raphson Method and roots, used in computer science
			UNIT-II **Interpolation and Extrapolation :**Finite Differences, The operator E-Newton's Forward and Backward Differences, Newton's dividend differences formula, Lagrange's Interpolation formula for unequal Intervals, Gauss's Interpolation formula, Starling formula, Bessel's formula, Laplace, Everett formula.	**CO2:** ➢ Able to get knowledge about Interpolation and Extrapolation
			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	**CO3:** ➢ Familiar with propositional calculus.

			three, eight rule.	
			UNIT-IV **Solution of Linear Equation:** Gauss's Elimination method and Gauss's Siedel iterative method.	**CO4:** ➢ Understanding the linear equations using different methods.
			UNIT-V **Solution of Differential Equations:** Euler's method, Picard's method, Fourth-order RangaKutta method.	**CO5:** ➢ Formulate Limit, Continuity and Differentiability

Suggested Books:

1. Scarbourogh, "Numerical Analysis".
2. Gupta & Bose S.C. "Introduction to Numerical Analysis, "Academic Press, Kolkata, 3. S.S.Shashtri,"Numerical Analysis", PHI

S.No.	Name of the Course	Course Code	Course Content	Course Objective
	Numerical Methods	**C-205**	**UNIT-I** **Roots of Equations:** Bisections Method, False Position Method, Newton's Raphson Method, Rate of convergence of Newton's method.	**CO1:** ➢ Reason mathematically about basic discrete structures such as numbers, Newton's Raphson Method and roots, used in computer science
			UNIT-II **Interpolation and Extrapolation :**Finite Differences, The operator E-Newton's Forward and Backward Differences, Newton's dividend differences formula, Lagrange's Interpolation formula for unequal Intervals, Gauss's Interpolation formula, Starling formula, Bessel's formula, Laplace, Everett formula.	**CO2:** ➢ Able to get knowledge about Interpolation and Extrapolation
			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.	**CO3:** ➢ Familiar with propositional calculus.
			UNIT-IV **Solution of Linear Equation:** Gauss's Elimination method and Gauss's Siedel iterative method.	**CO4:** ➢ Understanding the linear equations using different methods.
			UNIT-V **Solution of Differential Equations:** Euler's method, Picard's method, Fourth-order RangaKutta method.	**CO5:** ➢ Formulate Limit, Continuity and Differentiability

BACHELOR OF COMPUTER APPLICATION (B.C.A.)

DETAILED SYLLABUS
THIRD SEMESTER

S.No.	Name of the Course	Course Code	Course Content	Course Objective
1	**Data Base Management System**	**C-301**	**UNIT-I** **Introduction:** Database System Concepts, Database Users, and Architecture Introduction to Database System with example, Introduction to Traditional File Oriented System, Characteristics of the Database Approach, Components of Database System, Database Users, Advantages and disadvantages of Using a DBMS, Structure of DBMS, Database Schemas and Instances , DBMS Architecture, Data Independence, Database Languages and Interfaces, Classification of Database Management Systems.	**CO1:** ➢ **To understand** Database System Concepts, Database Users, and Architecture ➢ Apply knowledge of database for real life applications.
			UNIT-II Data Modelling & Relational Database Management System Data Modelling Using the Entity Relationship Model: Entity Types, Entity Sets, Attributes, Keys, Relationships, Relationship Types, Roles, and Structural, Constraints, Weak Entity Types, ER Diagrams, Naming Conventions, Design Issues.	**CO2:** ➢ Identify the basic concepts and various data model used in database design ER modelling concepts and architecture use and design queries using SQL.
			UNIT-III **The Relational Data Model**: Relational Constraints and the Relational Algebra: Relational Model Concepts, Relational Constraints and Relational Database Schemas Update Operations and Dealing with Constraint Violations, Basic Relational Algebra Operations, Additional Relational Operations, Examples of Queries in Relational Algebra.	**CO3:** ➢ Apply relational database theory and be able to describe relational algebra expression, tuple and domain relation expression queries
			UNIT-IV	**CO4:**

<table>
<tr><td></td><td></td><td></td><td>SQL:SQL and Database Design Theory and Methodology Structured Query Language The Relational Database Standard: Data Definition, Constraints and Schema Changes in SQL, Types of SQL Commands, SQL Operators and their Procedure, Insert, Delete, and Update Statements in SQL Queries and Sub Queries, Aggregate Functions, Joins,Unions,Intersection,Minus, Views (Virtual Tables) in SQL. Functional Dependencies and Normalization for Relational Databases: Informal Design Guidelines for Relation Schemas, Functional Dependencies, Armstrong Rules, Closure of Attributes, Normal Forms Based on Primary Keys, General Definitions of Second and Third Normal Forms, Boyce Codd Normal Form.</td><td>➢ Recognize/ identify the purpose of query processing and optimization and also demonstrate the basic of query evaluation.
➢ Identify and solve the redundancy problem in database tables using normalization.</td></tr>
<tr><td></td><td></td><td></td><td>UNIT-V
Transaction Processing: Concurrency Control and Distributed Database Transaction Processing Concepts: Introduction to Transaction Processing, Transaction and System Concepts, Desirable Properties of Transactions, Concurrency Control Techniques, Locking Techniques for Concurrency Control, Concurrency Control Based on Timestamp Ordering.</td><td>CO5:
➢ Apply and relate the concept of transaction, concurrency control and recovery in database.</td></tr>
<tr><td colspan="5">Suggested Books:
1. A.K.Majumdar, P. Bhattacharya, “Database Management Systems”, TMH, 1996.
2. Bipin Desai, “An Introduction to database systems”,Galgotia Publications, 1991</td></tr>
<tr><td>2.</td><td>E-Commerce and ERP</td><td>C-302</td><td>UNIT-I
Introduction: Defining E-Commerce, Main Activities of Electronic Commerce, Benefits of E-Commerce, Goals of Electronic Commerce, Main Components of E-Commerce, Functions of Electronic Commerce, Communication, Process Management, Service Management, Transaction Capabilities, Process of E-Commerce, Types of E- Commerce, Role of Internet and Web in E- Commerce, Technologies Used in E-</td><td>CO1:
➢ To understand the Concept of E-commerce and Business Strategy in Electronic Age and different models of E-Commerce.</td></tr>
</table>

			Commerce Systems, Scope of E- Commerce, E-Business Models.	
			UNIT-II **E-Commerce Activities**: Various Activities of E-Commerce, Various Modes of Operation Associated with E- Commerce, Matrix of E- Commerce Types, Elements and Resources Impacting E- Commerce and Changes, Types of E- Commerce Providers and Vendors, Man Power Associated with E- Commerce Activities, Opportunity Development for E- Commerce Stages, Development of E- Commerce Business Case, Components and Factors for the Development of the Business Case, Steps to Design and Develop an E-Commerce Website.	**CO2:** ➢ Evaluate E-commerce models and identify the requirements for starting up and operating E-business sites.
			UNIT -III **Internet** :The Backbone for E- Commerce: Early Ages of Internet, Networking Categories, Characteristics of Internet, Components of Internet, Internet Services, Elements of Internet, Uniform Resource Locators, Internet Protocol, Shopping Cart, Cookies and E-Commerce, Web Site Communication, Strategic Capabilities of Internet. Implementation of E-Commerce: WWW.EBAY.COM, B2C Website-Registration, Time factor, Bidding process, Growth of eBay, PayPal, New Trend in Making Payments Online-National Electronic Funds Transfer.	**CO3:** ➢ Administer and Maintain B2B E-Business sites. ➢ Evaluate E-commerce models and identify the requirements for starting up and operating E-business sites.
			UNIT-IV	**CO4:**

			ISP, WWW and Portals: Internet Service Provider (ISP), World Wide Web (WWW), Portals, Steps to build homepage, Metadata, Advantages of Portal, Enterprise Information Portal (EIP).E-Marketing: Traditional Marketing, E- Marketing, Identifying Web Presence Goals, Achieving web presence goals, Uniqueness of the web, Meeting the needs of website visitors, Maintaining a Website, Metrics Defining Internet Units of Measurement, Online Marketing, Advantages of Online Marketing. Content: format and access, Maintaining a Website- Metrics Defining Internet Units of Measurement, Online Marketing, Advantages of Online Marketing. E- Security: Security on the Internet, Network and Website Security Risks, Denial, of, Service attacks, Viruses, Unauthorized access to a computer network, Vulnerability of Internet Sites, Network and Website Security, Transaction security and data protection, Security audits and penetration testing, E-Business Risk Management Issues, Firewall, Network policy, Advanced authentication mechanism, Packet filtering, Application gateways, Defining Enterprise Wide Security Framework.	➢ Ability to create an integrated marketing communications plan which includes promotional strategies ➢ Define and apply knowledge of various aspects of managerial decision making related to pricing strategy and tactics. ➢ Able to know about E- Security and various attacks.
			UNIT -V E- Payment Systems: Electronic Funds Transfer, Digital Token Based E- Payment Systems, Modern Payment Systems, Steps for Electronic Payment, Payment Security, Net Banking, Customer Relationship Management: Customer Relationship Management (CRM), Marketing automation, Enterprise customer management, Customer Relationship Management Areas, CRM Processes, Event triggers, business logic and rules repository, Decision support tools, Higher level statistical analysis, Forecasting and planning	**CO5:** ➢ Understand the Internet Architecture and Electronic Payment System. ➢ Able to get familiarity about Customer Relationship Management

			tools, True channel management, Workflow management, Collateral management, Electronic Customer Relationship Management, Need, Architecture and Applications of Electronic CRM	
Suggested Books: 1. The Story of India's First E-Commerce Company" by K Vaitheeswaran" 2. E – Commerce: Strategy, Technologies and Applications" by David Whiteley" 3. E-Commerce: An Indian Perspective" by P T Joseph"				
3.	**Computer Organization and Architecture**	**C- 303**	**UNIT I** **Computer Evolution:** Brief history of Computer, Classification of Computer, Structure of a Computer System, Arithmetic Logic Unit, Control Unit, Von Neumann Architecture.Integer Addition and Subtraction ,Floating point representation., Signed numbers, Binary Arithmetic, 1's and 2's Complements , Booths Algorithm, Hardware Implementation, IEEE Standards, Floating Point Arithmetic , The accumulator, Shifts, Carry and Overflow.Instruction Characteristics, CPU with Single BUS, Types of Operands, Types of Operations, Addressing Modes, Instruction Formats.	**CO1:** ➢ Understand the theory and architecture of central processing unit. ➢ Explain the organization of basic computer its design and the design of control unit.
			UNIT II **Processor Organization:** Parallelism and Computer arithmetic, Computer arithmetic associatively. Floating Point in the 8086, Programmers Model of 8086, Register Organization, 8086 Registers, Instruction Cycles, Addressing Modes.Micro operations, The Instruction cycle, Control of the CPU, Functional Requirements, Single, Two,Three bus structure, Execution of a complete instruction, Branching, Sequencing of Control Signals, Hardwired Control Unit, Micro-Programmed Control.	**CO2:** ➢ Analyze a detailed s/w & h/w structure of the Microprocessor. ➢ Analyze the properties of Microprocessors (8085/8086)

			UNIT III **Memory Organization:** Characteristics of Memory Systems, Main Memory, Types of Memory, Memory system considerations, Design of memory subsystem using Static, Dynamic Memory Chips, Memory interleaving **High Speed Memories:** Cache Memory,Structure of cache and main memory, Elements of Cache Design, Mapping functions, Replacement algorithms, External Memory, Virtual memory	**CO3:** ➢ Understanding the hierarchical memory system, cache memories and virtual memory
			UNIT IV **I/O Organization:** Input / Output Module:Need, Techniques, Interrupt Driven I/O, Basic concepts of an Interrupt , Response of CPU to an Interrupt, Design Issues, Priorities, Interrupt handling, Types of Interrupts**.**Data Transfer Techniques, Data Memory Access, Buses, Types of buses, I/O Interface, Synchronous and Asynchronous Data Transfer, Serial I/O, Input Devices, Output Devices, Multiprogramming vs. Multiprocessing, Comparison between closely coupled and loosely coupled Multiprocessor	**CO4:** ➢ Understanding the different ways of communicating with I/O devices and standard I/O interfaces
			UNIT V **Microprogramming:** Basic Principles, Features , Hardwired vs. micro programmed computers, Applications and advantages of microprogramming, Limitations of microprogramming, Computer Clock, MicroInstructions and its Control Path, Microcode, Machine Instruction**.** Parallel Organization, Instruction Set Architecture (ISA), RISC and CISC, Characteristics of CISC, Characteristics of RISC, RISC versus CISC, Vector Processing Requirements and Characteristics of vector processing	**CO5:** ➢ Demonstrate the working of central processing unit and RISC and CISC Architecture ➢ Learn the concepts of parallel processing, , Vector Processing Requirements and Characteristics of vector processing and inter processor communication.

Suggested Books:

1. Computer Organization & Architecture– by Stallings

2. Computer Organization and Architecture: Designing for Performanceby William Stallings 3. Computer Architecture and Organizationby John Hayes				
4.	**Operating System**	**C-304**	**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	**CO1:** ➢ To understand the basic components of a computer operating system, and the interactions among the various components. ➢ Explain various memory management techniques, concept of thrashing and virtual memory
			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	**CO2:** ➢ Describe the various CPU scheduling algorithms and various synchronization problems.
			UNIT-III **Deadlocks:** System Model, Deadlock Characterization, Methods for Handling Deadlocks, Deadlock prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock	**CO3:**
			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	**CO4:** ➢ Use disk management and disk scheduling algorithms for better utilization of external memory

			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.	**CO5:** ➢ Recognize file system interface, Directory Structure, protection and security mechanisms.
Suggested Books: 1. Silbersachatz and Galvin, “Operating System Concepts”, Person, 5th Ed. 2001 2. Madnick E., Donovan J., “Operating Systems:, Tata McGraw Hill, 2001 3. P C Software for Windows by R K Taxali 4.Unix Shell Programming” by Yashavant P Kanetkar				
5.	**Statistical Method and Application**	**C-305**	**UNIT I** Classification of data, Tabulation of data, Preparation of frequency distribution, Presentation of data through histogram, frequency polygon, frequency curve	**CO1:** ➢ Analyze the data pertaining to attributes and to interpret the results.
			UNIT II **Measures of Central Tendency:** Computation of Arithmetic mean, median and mode for ungrouped data and grouped data, Verification of median through ogives.	**CO2:** ➢ **Understanding the basic Measures of Central Tendency**
			UNIT III Measures of dispersion: Computation of Range, Quartile deviation, mean deviation and Standard	**CO3:** ➢ know about Measures of dispersion techniques

			deviation, coefficient of variation. (Numerical Applications Only)	
			UNIT IV Concept of Skewness, Karl Pearson's and Bowley's Coefficients of Skewness(Numerical Applications Only)	**CO4:** ➢ Able to get acquaintance about Pearson's correlation coefficient techniques
			UNIT V Meaning of Correlation, types of correlation, correlation coefficient, Karl Pearson, spearman's rank correlation coefficient. (Numerical Applications Only)	**CO5:** ➢ To recognize and evaluate the relationship between two quantitative variables through simple linear correlation and regression .

Suggested Books:

1. StatisticalMethods,"Dr.S.P. Gupta,SultanChand&Sons".
2. Quantitative Techniques by "C. Sathyadevi,S. Chand".
3. FundamentalofMathematicalStatistics,"S.C.Gupta&V.K.Kapoor,SultanChand"
4. StatisticalMethods,"SnedecorG.W.&CochranW.G.oxford&+DII"
5. Elementsof Statistics,"Mode.E.B.,PrenticeHall"

BACHELOR OF COMPUTER APPLICATION (B.C.A.)

DETAILED SYLLABUS

FOURTH SEMESTER

S.No.	Name of the Course	Course Code	Course Content	Course Objective
1.	Java Programming	C-401	**UNIT-I** Introduction, Java Tokens, Java Statements, Command Line Arguments, Programming Style. Constants, Variables and	**CO1:** ➢ Learn basic concepts Java Programming

			Data Types Constants, Variables, Data Types, Declaration of Variables, Giving Values of Variables, Scope of Variables, Symbolic Constants, Type Casting, Getting Values of Variables, Standard Default Values, Java Program Structure, Java Virtual Machine.	Language, data types and Scope of Variables.
			UNIT-II **Operators, Expressions and Statements**: Arithmetic Operators, Relational Operators, Logical Operators, Assignment Operators, Increment and Decrement Operators, Conditional Operators, Bitwise Operators, Special Operators, Arithmetic Expressions, Evolution of Expressions, Precedence of Arithmetic Operators. Decision Making and Branching: Introduction, Decision Making with if Statement, Simple if Statement, The if... else Statement, Nesting of if ... else Statements, else if Ladder, switch Statement, ?: Operator. Decision Making and Looping: Introduction, while Statement, do Statement, for Statement.	**CO2:** ➢ Acquire knowledge of decision statement and control structures.
			UNIT-III **Classes, Objects and Methods:** Defining a Class, Creating Objects, Accessing Class Members, Constructors, Methods Overloading, Static Members, Nesting of Methods, Inheritance: Extending a Class, Overriding Methods, final Variables and Methods, Final Classes, Finalize Methods, Abstract Methods and Classes, Visibility Control. Arrays, One, Dimensional Arrays, Creating an Array, Two Dimensional Arrays, Strings, Vectors, Wrapper Classes.	**CO3:** ➢ To understand and use different class methods objects and array.
			UNIT-IV **Interfaces and Packages**: Introduction, Defining Interfaces, Extending Interfaces, implementing Interfaces, Accessing Interface Variables. Packages: Introduction, Java API Packages, Using system Packages, Naming Conventions,	**CO4:** ➢ Defining various Java Packages and Multithreaded Programming

			Creating Packages, Accessing a Packages, Using a Package, Adding a Class to a Package, Hiding Classes. Multithreaded Programming: Introduction, Creating Threads, Extending the Thread Class, Stopping and Blocking a Thread, Life Cycle of a Thread, Using Thread Methods, Thread Exceptions, Thread Priority, and Synchronization.	
			UNIT-V **Applet Programming:** Introduction, How Applets Differ from Application, Preparing to Write Applets, Building Applet Code, Applet Life Cycle, Creating an Executable Applet, Designing a Web Page, Applet Tag, Adding Applet to HTML File, Running the Applet, More About Applet Tag. Managing Errors and Exceptions: Introduction, Types of Errors, Exceptions, Syntax of Exception Handling Code, Multiple Catch Statements, Using finally Statement, Throwing Our Own Exceptions, Using Exceptions for Debugging.	**CO5:** ➢ Create wide range of Applications and Applets using Java. ➢ To get knowledge about java applet programming and exception handling.

Suggested Books:

1.E. Balagurusamy, Programming with Java, A Primer Second Edition, Tata McGraw Hill, New Delhi.
2.P.Naughton and H. Schildt, JAVA: The Complete Reference, TMH, New Delhi 2005.
3.D.Jana, Java and Object Oriented Programming Paradigm, PHI, New Delhi, 2005

2.	Web Technology using PHP and MYSQL	C-402	**UNIT I** **PHP:** Introduction to PHP Evaluation of PHP, Basic Syntax, Defining variable and constant, PHP Data type, Operator and Expression, Decisions and loop Making Decisions, Doing Repetitive task with looping, Mixing Decisions and looping with Html. Function: Define a function, Call by value and Call by reference, Recursive function, String Creating and accessing. String Searching & Replacing String, Formatting String, String Related Library function.	**CO1:** ➢ To be able to implement basic programming concept using PHP ➢ Understand, analyze and apply the role of languages like HTMLand PHP.

			UNIT II **Array:** Anatomy of an Array, Creating index based and Associative array Accessing array. Element Looping with Index based array, Looping with associative array using each () and foreach(),Some useful Library function. Handling Html Form with PHP Capturing Form, Data Dealing with Multi-value filed, and Generating File uploaded form, redirecting a form after submission.	**CO2:** ➢ To get understanding of arrays and dynamic form for capturing the data.
			UNIT III **Working with file and Directories:** Understanding file& directory, Opening and closing, a file, Coping, renaming and deleting a file, working with directories, Creating and deleting folder, File Uploading & Downloading.	**CO3:** ➢ Understanding of various operations on file and Directories
			UNIT IV **Session and Cookie:** Introduction to Session Control, Session Functionality What is a Cookie, Setting Cookies with PHP. Using Cookies with Sessions, Deleting Cookies, Registering Session variables, Destroying the variables and Session. 8. Database Connectivity with	**CO4:** ➢ Able to understand the concepts of session and cookies in web design.
			UNIT V **MySQL:** Introduction to RDBMS, Connection with MySQL Database, Performing basic database operation (DML) (Insert, Delete, Update, Select), Setting query parameter, Executing query Join (Cross joins, Inner joins, Outer Joins, Self joins.) Exception Handling Understanding Exception	**CO5:** ➢ Create connection with database(mysql), manipulation of data and exception handling.

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<tr><td></td><td></td><td></td><td>and error, Try, catch, throw. Error tracking and debugging.</td><td></td></tr>
<tr><td colspan="5">Suggested Books:
1.V.Rajaraman, Analysis and Design of Information System, Pearson Education, 1991.
2. J.A.Senn, “Analysis and Design of Information Systems”
3. J.K.Whiten, L.D.Bentley, V.M.Beslow, “System Analysis and Design Methods”,</td></tr>
<tr><td>3</td><td>Artificial Intelligence</td><td>C-403</td><td>UNIT-I
AI Concepts, Various definitions of AI, Knowledge, Knowledge Pyramid, People and Computers: What computers can do better that people, what people can do better than computers, Characteristics of AI Problems, Problem Representation in AI, Components of AI, AI Evolution, Application Areas of AI, History of AI, The Turing Test and The Revised Turing Test</td><td>CO1:
➢ Understand the basics of the theory and practice of Artificial Intelligence as a discipline and about intelligent agents.
➢ The student will learn to apply knowledge representation techniques and problem solving strategies to common AI applications.</td></tr>
<tr><td></td><td></td><td></td><td>UNIT-II
Expert System: Components of Expert System: Knowledge Base, Inference Engine, User Interface, Features of Expert System, Expert System Life Cycle, Categories of Expert System, Rule Based vs. Model Based Expert Systems, Advantages/Limitations of Expert System, Developing an Expert System: Identification, Conceptualization, Formalization, Implementation, Testing, Using an Expert System, Application Areas of Expert System</td><td>CO2:

Understand the theoretical base of the expert system and
its development process.
Analyze the development process of expert system through various case studies.</td></tr>
<tr><td></td><td></td><td></td><td>UNIT-III
AI and Search Process: Brute Force Search,Depth First/Breadth First Search,Heuristic Search: Hill Climbing,Constraint Satisfaction, Mean End Analysis,Best First Search, A* Algorithm, AO* Algorithm, Beam Search.</td><td>CO3:

➢ Able to learn different type of AI search process algorithm.</td></tr>
<tr><td></td><td></td><td></td><td>UNIT-IV</td><td>CO4:</td></tr>
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			Natural Language Processing: Introduction, Need, Goal, Fundamental Problems in Natural Language Understanding, How People overcome Natural Language Problems, Speech Recognition: Introduction, Advantages and Approaches, Introduction to Robotics: Parts of a Robot, Controlling	➢ To know about Natural Language Processing techniques and problems
			UNIT-V **Applications:** Communication ,Communication as action, Formal grammar for a fragment of English, Syntactic analysis, Augmented grammars, Semantic interpretation, Ambiguity and disambiguation, Discourse understanding, Grammar induction, Probabilistic language processing, Probabilistic language models, Information retrieval, Information Extraction, Machine Translation.	**CO5:** ➢ The student will learn to apply knowledge representation techniques and problem solving strategies to common AI applications.
Suggested Books: 1. V S Janakiraman, “Foundation of Artificial Intelligence and Expert Systems” 2. Dan W. Patterson, “Introduction to Artificial Intelligence and Expert Systems”				
4.	Computer Network	C-404	**UNIT I** **Introduction:** Definition of a Computer Network,Components of a computer network**,**Types of Network: Based on Topology (Bus,Star,Ring Mesh,Tree), Based on Size Technology and ownership (LAN, MAN, WAN). Network topologies,Linear Bus Topology,Ring Topology,Star Topology,Hierarchical orTree Topology,Topology Comparison, Considerations when choosing a Topology: Switching, Circuit switching,Message switching,Packet switching,Implementation of packet switching, Relationship between Packet Size and Transmission time,Comparison of switching techniques: Multiplexing, FDM,Frequency division multiplexing,WDM,Wavelength division multiplexing, TDM,Time division multiplexing.	**CO1:** ➢ Obtain the knowledge about basic computer network terminologies. ➢ Able to know about switching and multiplexing

			UNIT II **Network Software & Network Standardization**: Introduction: Networks Software, Protocol hierarchy,Design issues for the layers,Merits and De-merits of Layered Architecture,Service Primitives: Reference models,The OSI Reference Model,The TCP/IP Reference Model, Comparison of the OSI & the TCP/IP Reference Model	**CO2:** ➢ Understand computer network basics, network architecture, TCP/IP and OSI reference models.
			UNIT III **Data Link Layer:** Services provided to the Upper Layer, Framing, Error Control, Flow Control, IEEE Standards for MAC Sublayer, Network Layer: Services provided to the Upper Layer: Routing Algorithms (Centralized, Distributed),Congestion Control (Token Based and Non Token Based), Internetworking.	**CO3:** ➢ Describe data link protocols, multi-channel access protocols and IEEE 802 standards for MAC ➢ Obtain the knowledge about error deduction and correction in Data Link Layer
			UNIT IV **Data Communications**: **Introduction:** Theoretical basis for communication, Fourier analysis, Band limited signals, Maximum data rate of a channel: Transmission impairments, Attenuation distortion, Delay distortion, Dispersion, Noise: Data transmission modes, Serial & Parallel, Simplex, Half duplex & full duplex, Synchronous & Asynchronous transmission:	**CO4:** ➢ To get knowledge about basic data communication Terminologies and Transmission impairments
			UNIT V Transmission Medium: Introduction: Transmission medium,Guided & Unguided Transmission medium, Twisted pair, Coaxial cable, Optical fiber, Comparison of fiber optics and copper wire: Wireless transmission.	**CO5:** ➢ To get basic understanding of basic transmission medium and comparisons.
Suggested Books: 1. W. Stallings, “Data and Computer Communication”, Pearson Education. 2. A. S. Tanenbaum, “Computer Network”, 4th, Edition, Pearson Education. 3. Forouzan, “Data Communication and Networking”, 2nd Edition, Tata McGraw Hill.				
5.	Optimization Techniques	C-405	**UNIT-I** Basics of operation research (OR): Characteristics of	**CO1:**

			OR,Necessity of OR in industry,OR and decision making,role of computers in OR.Linear Programming: Formulations and graphical solution of (2 variables) canonical and standard terms of linear programming problem.	➢ Ability to apply the theory of optimization methods and algorithms to develop and for solving various types of optimization problems.
			UNIT-II Algebraic solution: Simplex methods,Charnes method of penalties,two phase simplex method.	**CO2:** ➢ Ability to go in research by applying optimization techniques in problems of Engineering and Technology.
			UNIT-III Transportation Model: Definition,formulation and solution of transportation models,The row, minima, column,minima,matrix,minima and Vogel's approximation methods. Assignment model: Definition of assignment model,comparison with transportation model,formulation and solution of assignment model.	**CO3:** ➢ Understand the concept of extrema to create, critical path and analyzing for application in Engineering. ➢ Applying the concept of extrema to evaluate inventory and replenishment problems
			UNIT-IV Sequencing Problem: Processing of n jobs through 2 machines,processing n jobs through 3 machines,processing 2 jobs through m machines.	**CO4:** ➢ Analyze the concept of simulation in different ways by simulation techniques methods.
			UNIT-V Game Theory: Characteristics of games, maxima,minimax criteria of optimality,dominance property,algebraic and graphical method of solution of solving 2 x 2 games	**CO5:** ➢ Remember the concept of matrices, maxima and minimize to evaluate the value of the game and create the model

Suggested Books:

1. Introduction to Management Science Operations Research,“KantiSwarup”.
2. Operations Research Quantitative Techniques For Management,“V. K. Kapoor”.
3. Nonlinear Programming: Theory and Algorithms“by Mokhtar S Bazara and C M Shetty”.

BACHELOR OF COMPUTER APPLICATION (B.C.A.)
DETAILED SYLLABUS
FIFTH SEMESTER

S.No.	Name of the Course	Course Code	Course Content	Course Objective
1	Network Security	C-501	**UNIT-I** **Network Security: Introduction:** OSI Security Architecture-Classical Encryption techniquesCipher Principles,Data Encryption Standard, Block Cipher Design Principles and Modes of Operation	**CO1:** ➢ To know about the basic understanding of OSI architecture and encryption techniques.
			UNIT-II **Public Key Cryptography:** Key Management, Diffie-Hellman key Exchange-Elliptic Curve Architecture and Cryptography, Introduction to Number Theory, Confidentiality using Symmetric Encryption, Public Key Cryptography and RSA.	**CO2:** ➢ To understand the cryptography and key exchange algorithm.
			UNIT-III **Authentication and Hash Function:** Authentication requirements, Authentication functions –Message Authentication Codes, Hash Functions, Security of Hash Functions and MACs,MD5 message Digest algorithm, Secure Hash Algorithm, RIPEMD,HMAC Digital Signatures, Authentication Protocols, Digital Signature Standard	**CO3:** ➢ To get knowledge about different authentication function and digital signature standard

			UNIT-IV **Network Security:** Authentication Applications: Kerberos,X.509 Authentication Service, Electronic Mail Security, PGP, S/MIME,IP Security, Web Security.	**CO4**: ➢ Able to understand authentication application and services such as Kerberos, S/MIME, IP sec.
			UNIT-V **System Level Security:** Intrusion detection, password management, Viruses and related Threats, Virus Counter measures, Firewall Design Principles, Trusted Systems.	**CO5:** ➢ To explain various malware detection techniques, firewall design principles and trusted system.

Suggested Books:

1. William Stallings,"Cryptography and Network Security,Principles and Practices", Prentice Hall of India,Third Edition,2003.
2. AtulKahate-"Cryptography and Network Security",Tata McGraw,Hill,2003.
3. Bruce Schneier, "Applied Cryptography",John Wiley & Sons Inc, 2001.

2.	Visual Basic .NET	**C-502**	**UNIT-I** **Visual Basic .NET and the .NET Framework:** Introduction to .net framework ,Features, Common Language Runtime (CLR) ,Framework Class Library(FCL).Visual Studio.Net – IDE, Languages Supported, Components. Visual Programming, VB.net, Features, IDE, Menu System, Toolbars, Code Designer, Solution Explorer, Object Browser, Toolbox, Class View Window, Properties Window, Server Explorer, Task List, Output Window, Command Window.	**CO1:** ➢ Able to Use and understand Visual Studio IDE to design application.
			UNIT-II **Elements of Visual Basic .net:** Properties, Events and Methods of Form, Label, TextBox, ListBox, ComboBox, RadioButton, Button, Check Box, Progress Bar, Date Time Picker, Calendar, Picture Box, HScrollbar,VScrollBar, Group Box, ToolTip, Timer.	**CO2:** ➢ Develop GUI Application using Form Controls and its events.
			UNIT-III **Programming in Visual basic .net:** Data Types, Keywords, Declaring Variables and Constants, Operators,Understanding Scope and accessibility of variables, Conditional Statements, If- then, If- then-else, Nested If, Select Case, Looping Statement, Do loop, For Loop,For Each,Next Loop, While Loop, Arrays, Static and Dynamic.	**CO3:** ➢ Apply decision statement and control statements in the language.
			UNIT-IV Functions, Built-In Dialog Boxes, Menus and Toolbar: Menus and toolbars, Menu Strip, Tool Strip, Status Strip, Built-In Dialog Boxes –Open File Dialogs, Save File Dialogs, Font Dialogs, Color Dialogs, Print Dialogs, InputBox, MsgBox, Interfacing With End user, Creating MDI Parent and Child, Functionsand	**CO4:** ➢ To understand and use different user interface options and various function

			Procedures, Built-In Functions, Mathematical and String Functions, User DefinedFunctions and Procedures.	
			UNIT-V Advanced Concepts in VB.Net: Object Oriented Programming, Creating Classes, Objects, Fields, Properties,Methods, Events, Constructors and destructors, Exception Handling, Models,Statements, File Handling, Using File Stream Class, File Mode, File Share, FileAccess Enumerations, Opening or Creating Files with File Stream Class, Reading andWriting Text using StreamReader and StreamWriter Classes, Data Access withADO.Net – What are Databases? Data Access with ServerExplorer,Data Adapter andDataSets, ADO.NET Objects and Basic SQL.	**CO5:** ➢ Apply Object Oriented concepts in GUI Application. ➢ Use Data access controls to store data in Database and retrieve it.
Suggested Books: 1. Jesse liberty :"Learning Visual Basic.net" 2. Steven Holzner: " VB.NETBlackBook " 3. Chuck Easttom: " LearnVB.NET"				
3.	Computer Graphics	**C-503**	**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.	**CO1:** ➢ Be able to understand the basics of computer graphics and conceptual framework for Interactive Graphics ➢ Understand the basics of computer graphics, different graphics systems and applications of computer graphics.

			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	**CO2:** ➢ Be familiar with display technologies and identify various computer Graphics Tools. ➢ Extract scene with different clipping methods and its transformation to graphics display device.
			UNIT III **Geometrical Transformation:** 2D Transformation,Homogeneous Coordinates and Matrix Representation of 2D Transformations, composition of 2D Transformations, the WindowtoViewport Transformations, Introduction to 3D Transformations Matrix.	**CO3:** ➢ Understand Graphical formula in3-D to 2-Dimensional objects.
			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.	**CO4:** ➢ To follow a series of stages collectively known as Graphics Pipeline and understanding the Curves & Surfaces
			UNIT V **Introductory Concepts:** Multimedia Definition,CD-ROM and the multimedia highway, Computer Animation (Design, types of animation, using different functions), 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	**CO5:** ➢ To be familiar with Multimedia applications and usage.

Suggested 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. D.Haran& Baker. Computer Graphics Prentice Hall of India, 1986				
4.	System Analysis and Design	C-504	**UNIT-I** Overview of Systems Concepts, Analysis and Design Life cycle,Introduction to System Concept: Characteristics of the system,Elements of a System,Types of Systems,Physical and Abstract System,Open and Closed System,Formal and Informal System,Introduction to Data And Information: Types of Information System,Categories of Information System,Needs of Information Systems,Qualities of Information System,Software DevelopmentLife Cycle (SDLC), Role and Attributes of System Analyst.	**CO1:** ➢ Understand the life cycle of a systems development project.
			UNIT-II System Planning and Requirements Determination System planning and initial investigation: Strategic Plan for Information processing, Tools for Planning, Problems in Planning, Need for requirement definition.	**CO2:** ➢ Understand the analysis and development techniques required as a team member of a medium-scale information systems development project
			UNIT-III Information gathering tools: Review of Literature, procedures and forms, Methodologies, Tools and Techniques of Analysis Systems Analysis and Design: Decision Tree, Data Dictionary, Decision Table, Structured English, Data Flow Diagram, Components of a DFD, Zero Level DFD,DFD Transformation and Decomposition, Context Diagram, Levelling a DFD, Feasibility Study: Economic Feasibility (Cost & Benefit Analysis), Organizational Feasibility, Technical Feasibility, Behavioural Feasibility study.	**CO3:** ➢ Able to know about information gathering tools such as DFD, decision tree, data dictionary..

			UNIT-IV System Design and Implementation Process of Design: Logical and Physical Design, Design Methodologies, Elements of Form Design, Design of Output, Design of Input, Design of File, Design of procedure, Audit Trail, System Implementation and Testing: Operational and Test Environment, Conversion Preparation, Database installation, Users Training and Final Report to Management, Creating a new System, Test Plan: Activity Network for system Testing, Types of Testing. .	**CO4:** ➢ Define the concept of designing and test environment
			UNIT-V System Quality Assurance, IT infrastructure Selection and Evaluation of Processing and Maintenance Quality Assurance: Quality factors specifications, Levels of Quality Assurance, Computer Hardware and Software Selection, Computer Configuration Determination, Requesting Proposal from Vendors, Evaluation of Vendor's Proposals,Acceptance of system, Evaluation of Processing, Need of Maintenance	**CO5:** ➢ Basic understanding about Quality Assurance, Computer Configuration Determination and maintenance.
Suggested Books: 1.V.Rajaraman, Analysis and Design of Information System, Pearson Education, 1991. 2. J.A.Senn, "Analysis and Design of Information Systems" 3. J.K.Whiten,L.D.Bentley,V.M.Beslow, "System Analysis and Design Methods",				
5.	Design and Analysis of Algorithm	C-505	**UNIT-I** **Basic Concepts of Algorithms:** Definition of algorithm, Characteristic of algorithm, Pseudo Codes &Time Complexity of Basic ControlStructures, Time and Space Complexity of Insertion Sort,Selection Sort, Heap Sort, Bubble Sort,Asymptotic Notations	**CO1:** ➢ Define the basic concepts of algorithms and analyze the performance of algorithms. ➢ Basic understanding of various sorting algorithm

			(Growth of Functions).	
			UNIT-II **Divide and conquer:**Binary Search, Maximum &Minimum, Merge Sort, Quick Sort, Greedy Method: General method,Knapsack Problem, JobSequencing with deadline- Optimal Storage on tapes,Huffman Codes.	**CO2:** ➢ Discuss various basic **Divide and conquer** algorithm and greedy approaches for developing algorithms.
			UNIT-III **DynamicProgramming:**Matrix, ChainMultiplications,Longest CommonSubsequence-Backtracking:General method,N QueensProblem,Sum of subsets.	**CO3:** ➢ Understanding and analysis of various dynamic and backtracking algorithms.
			UNIT-IV Basic Traversals and search techniques, techniques of binary trees, techniques of graphs: BFS, DFS.	**CO4:** ➢ Understanding of various graph traversal algorithms and trees.
			UNIT-V **Analysis ofGraph Algorithms:**Elementary Graph Algorithms,Multistage Graphs,Minimum Spanning Trees: Kruskal's& Prim's Algorithm,Single Source Shortest Path, Dijkstra's& Bellman Ford,All Pairs Shortest Path:Warshal Algorithm.	**CO5:** ➢ Discuss various Elementary Graph Algorithms and shortest path graph algorithms.

Suggested Books:

1. Thomas H. Coremen,"Introduction to Algorithms",PHI.
2. Horowitz&Sahani,"Fundamental of Algorithms",Galgotia.
3.Aho,"Design & Analysis of Computer Algorithms",Pearson.
4. Johnsonbaugh,"Algorithms",Pearson.

BACHELOR OF COMPUTER APPLICATION (B.C.A.)
DETAILED SYLLABUS
SIX SEMESTER

S.No.	Name of the Course	Course Code	Course Content	Course Objective
1.	Python Programming	C-601	**UNIT-I** Basic of Python, Features, Application, Python interpreter, Interpreters vs Compilers, Data Types, Identifiers and keywords, Literals, Strings, Assigning Values to Variables, Multiple Assignment, Basic Operators in Python: Arithmetic, Comparison, Assignment, Bitwise, Logical Membership Operators (in, not in), Identity Operators (is, is not), Operators Precedence.	**CO1:** ➢ Understand different data types and operators ➢ To read and write simple Python programs.
			UNIT-II Creating Python Programs: Input and Output Statements, Conditional Statement- if...else, Difference between break, continue and pass, Control statements (Looping- while Loop, for Loop, Loop Control nested nested loops).	**CO2:** ➢ To develop Python programs with conditionals and control statements.
			UNIT-III Python Strings, Accessing Values in Strings, String Special Operators, String Formatting Operator, Triple Quotes, Indexing and Slicing, Built-in String functions. Python Lists -Accessing Values in Lists, Updating Lists,	CO3: To define Python strings and to use Python data structures – lists, tuples, dictionaries.

			Basic List Operations, Indexing, Slicing, and Matrixes, Built-in List Functions & Methods Python Tuples - Accessing Values in Tuples, Updating Tuples, Delete Tuple Elements, Basic Tuples Operations, Indexing, Slicing Built-in Tuple Functions. Python Dictionary - Accessing Values in Dictionary, Updating Dictionary Python Programming, Delete Dictionary Elements, Built-in Dictionary Functions & Methods.	
			Unit-IV Functions: Defining a Function, Syntax, Calling a Function, call by value and call by reference, Pass by reference vs value, Function Arguments, Required arguments, Keyword arguments, Default arguments, Variable-length arguments, The return Statement, Scope of Variable.	**CO4:** ➢ To define and use Python functions, arguments and scope.
			Unit-V File Manipulation, Opening Text File, Working with a File on Python, The open function, File modes, The file object attributes, close() method, write() method, read() method, Files: Input, Files Output, Reading files, Renaming & deleting files, Writing into a file, remove() method.	**CO5:** ➢ To perform various input/output operations with files in Python.

Suggested Books:

1. Guido Van Rossum, Learning Python: Crash Course Tutorial Paperback – 22 July 2020.

2. Mark Lutz, Python Pocket Reference, 5th edition Feb, 2014 3. G van Rossum, An Introduction to Python				
2.	Software Engineering	C-602	**UNIT-I** **Introduction:** Definition of Software, Type of Software, Characteristic of Software, Attributes of Good Software, Definition of Software Engineering Software Engineering Costs, Key Challenges that Software Engineering Facing, System Engineering and Software Engineering.	**CO1:** Enables students to understand the various software characteristics and key challenges.S
			UNIT-II **Software Development Process Model:** Software Process. Software Process Model: The Waterfall Model, Evolutionary Development, Component- Based Software Engineering (CBSE). Process iteration: Incremental Delivery, Spiral Development: Rapid Software Development: Agile Methods, Extreme Programming, Rapid Application Development.	**CO2:** ➢ Plan a software engineering process life cycle , including the specification, design, implementation, and testing of software systems that meet specification, performance, maintenance and quality requirements
			UNIT-III **Design Concept:** Abstraction, Architecture, Patterns, Modularity: Cohesion, Coupling, Information Hiding, Functional Independence, Model, Client Server Model, Layered Model User Interface Design: Human-Computer Interaction, Information Presentation, Interface Evaluation; Design Notation	**CO3:** ➢ Analyze and translate a specification into a design, and then realize that design practically, using an appropriate software engineering methodology.
			UNIT-IV **Software Testing and Quality Assurance:** Verification and Validation, Techniques of Testing: Black-Box and	**CO4:**

			White Box Testing, Inspections. Level of Testing: Unit Testing. Integration Testing, Interface testing, System Testing, Alpha and Beta Testing, Regression Testing. Design of test Cases, Quality Management activities, Product and process quality, capability Maturity Model (CMM)	➢ Know how to develop the code from the design and effectively apply relevant standards and perform testing, and quality management and practice
			UNIT-V **Software Cost Estimation:** Introduction- Software Cost Factors, Software Cost Estimation Techniques, Stating Level estimation, Estimating Software Maintenance Costs Software Requirements Definition, Software Requirements Specification, Specification Techniques, Languages and Processors for Requirements	**CO5:** ➢ Able to elicit, analyze and specify software requirements through a productive working relationship with various stakeholders of the project ➢ understand the software cost estimation techniques
Suggested Books: 1. Ian Sommerville, Pearson Software Engineering, 10th Edition 2. Amiya Kumar Rath, Fundamental of Software Engineering. 3. Roger's Pressman, McGrewHill, Software Engineering a practitioner Approach				
3.	Soft Skills	C-603	**UNIT I: Conversational &Social Skills:** Definition of Conversation, Speech and Listening and Conversation, Rules of Conversation, Conversation and Personality, Importance of Conversation; Social Skills: Role of Communication; Purposeful Socializing, Attributes: Effective Communication, Relationship Management; Respect, Improvement Techniques: Feedback, Goal Setting, Adopting Interpersonal Skills.	**CO1:** ➢ To understand the conversation competencies and socialization
			UNIT II: Motivation Skills: Motivation: Definition, Sources of Motivation: Initiative, Willingness To Work, Eagerness to take on Work, Initiative; Learning	**CO2:** ➢ Able to get knowledge about various motivational aspects and learning.

			Ability, Learning And Analysis; Motivating Others: Techniques, Understanding; Individual Motivation; Mobilizing Optimal Performance, Praise and Compliment, Goal Setting for Individual Employee, Trust in the Working Hands.	
			UNIT III: Work-Place Skills: Managing Stress, Techniques: Application of 4 A's, Avoid, Alter, Access, Adapt, Resilience: Flexibility in Thought and Behavior, Tolerance and Self-Belief, Team-Work and Communication.	**CO3:** ➢ Able to analyse the knowledge of 4 A's and team work capabilities**.**
			UNIT IV: Creativity: Creativity: Definition, Characteristics of Creative Person: Fluency, Originality, Curiosity, Compassion in Leadership, Communication Skills, Listening and Responding, Speaking Skills, Positive Thinking: Controlling Mind.	CO4: ➢ To understand the leadership and communication skills.
			UNIT V: Critical Thinking: Critical Thinking: Definition Abilities: Discerning Facts and Claims Credibility Analysis, Identifying Valid Reasons, Distinguishing Relevant from Irrelevant Fact/Claims, Detecting Bias, Knowing the Hidden Motives, Creative Methods, Features	CO5: Able to specify the irrelevant facts, hidden moves and creative features.
4.	Professional Skills and Human Values	C-604	**UNIT I:** Professional Ethics: Value based Life and Profession, Professional Ethics and Right Understanding, Competence in Professional Ethics, Issues in Professional Ethics – The Current Scenario, Vision for Holistic Technologies, Production System and Management Models.	**CO1:** Explain the importance of human resources and their effective management in organizations. Comprehend the role and function of human resource management in industry .

			UNIT II: 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, c) Ability to identify and develop appropriate technologies and management patterns for above production systems, Case studies of typical holistic technologies, management models and production systems, Strategy for transition from the present state to Universal Human Order: a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers b) At the level of society: as mutually enriching institutions and organizations	**CO2:** ➢ Analyze the key issues related to administering the human elements such as motivation, compensation, appraisal, career planning, diversity, ethics, and training
			UNIT III: Specialized Knowledge, Competency, Honesty and Integrity, Accountability, Self-Regulation, Professional appearance, Reliable, Ethical behavior, Professional Code of Ethics, Accountable, Positive attitude, Separates personal and professional, Emotional control, Respectful of others, Strong communicator, Possesses soft skills	**CO3:** ➢ Identify and explain the importance of integrity, ethics, emotional balance and soft skills.
			UNIT IV: Understanding the need, basic guidelines, content	**CO4:**

			and process for Value Education, Self-Exploration, Relationship and Physical Facilities- the basic requirements for fulfillment 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.	➢ Correct evaluation of happiness, prosperity, human aspiration and value education.
			UNIT V: Work place rights and responsibility, Norms of professional conduct vs profession, Responsibility, obligation and moral values in professional ethics, Emotional Intelligence, Value education, Basic theories, case studies and examples.	**CO5:** ➢ Explain the concept and business relevance of ethics and emotional intelligence.

Program Outcomes (PO)

PO1	**Computational information**	Recognise and use mathematical organisation, computation, and domain knowledge to conceptualise computer models free from obvious downsides.
PO2	**Difficulty Analysis**	Ability to categorise, critically assess, and prepare complex computing problems using computer knowledge and request domains basics.
PO3	**Technical Implementation Skills**	The ability to choose modern computing tools, as well as the abilities and methods required for unique software solutions
PO4	**Proficient and Value Education**	At the level of individuals socially and ecologically responsible engineers and technologists. Identify the need and enlarge the ability to appoint in professional education as a Computing qualified.
PO5	**Mission Administration**	Knowledge of computing along with the ability to recognise administration and computing philosophy is necessary for project management in multidisciplinary settings.
PO6	**Presentation and communication skills**	Knowing excellent documentation and presentations can help students to communicate with the computing society and culture.
PO7	**Professional Competence and Team Ability**	Ability to job as a part or manager in various teams in multidisciplinary situations.
PO8	**Modernization and Private Enterprise**	Classify opportunities, private enterprise dream and use of original thoughts to build worth and means for the betterment of the human being and the world.
PO9	**Design / Development of Solutions**	Understand, analyse and develop computer programs in the areas related to algorithm, web design and networking for efficient design of computer based system.
PO10	**Critical thinking**	Problem solving abilities and business practices which aids to become more productive and thoughtful evaluation of information

Program Specific Outcome (PSO)

PSO1	An ability to enhance the application of knowledge of theory subjects in diverse fields.
PSO2	Develop language proficiency to handle corporate communication demands.
PSO3	Preparing students for various technology areas such as computers applications, computer networks, software development, JAVA, database concepts, programming.
PSO4	In order to enhance programming skills of the students, the concept of project development in using the technologies learnt during the semester has been introduced.
PSO5	To enhance knowledge in Artificial Intelligence, Expert System, Natural Language Processing, Robotics in order to provide the exposure for real life application.
PSO6	Preparing students for future aspects by building and improving their creativity, social awareness, human values, soft skills and general knowledge.
PSO7	Encouraging students to convert their start-up idea to reality by implementing.
PSO8	Ability to understand the changes or future trends in the field of computer application.
PSO9	Ability to identify, formulate, analyse and solve problems of programming using different languages such as C, C++, java, python.
PSO10	Ability to enhance the business and communication skills in order to identify the components and factors for the development and management of business cases