Institute of Engineering & Technology
Khandari Campus, Agra

BACHELOR OF ENGINEERING (B.E.) DEGREE

Course Structure & Evaluation Scheme

Approved for 3rd, 4th Year only

(Civil Engineering)

w.e.f. 2020-21

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

Undergraduate Degree Courses in Engineering & Technology

BACHELOR OF ENGINEERING (CIVIL ENGINEERING)

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

A. Definition of Credit:

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

B. Structure of Undergraduate Engineering program:

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

C. Course code and definition:

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

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

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Civil Engineering

Table Structure of B.E. Program

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

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B.E I Year (Semester-I) All Branches
Choice Based Credit System (Scheme of Studies & Examinations)

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

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

B.E I Year (Semester-II) All Branches
Choice Based Credit System (Scheme of Studies & Examinations)

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

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

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

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

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

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

Dean(Academics) **Director**

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

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

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

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

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

semester. This evaluation shall be based on presentation of Training report and viva.

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

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

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

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

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

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

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

B.E IV Year (Semester-VIII) Engineering

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

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

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

List of Departmental Electives

Departmental Elective – I

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

Departmental Elective – II

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

Departmental Elective – III

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

Departmental Elective – IV

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

Departmental Elective – V

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

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

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

PROGRAMME OUTCOMES FOR B.TECH. (CIVIL ENGINEERING)

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

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

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

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

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

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

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

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

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

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

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

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

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

PROGRAM SPECIFIC OUTCOMES (PSOs)

Engineering Graduates will be able to:

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

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

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

Syllabus of

UNDERGRADUATE DEGREE COURSE

Bachelor of Engineering

III Semester

Civil Engineering

Institute of Engineering & Technology, Khandari Campus

Dr. B R Ambedkar University, Agra

Effective from session: 2019-20

MATHEMATICS-III

COURSE CODE: BSC-301

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

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

Course Outcomes:

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

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

Unit – I:

Fourier Transform :

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

Unit- II:

Functions of a Complex Variable and Conformal mapping:

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

Unit- III:

Integration of Complex Functions:

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

Unit- IV:

Curve- Fitting & Probability:

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

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Unit- V:

Statistical Methods:

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

Books Recommended:

1. R.K. Jain & S.R.K. Iyengar; Advanced Engineering Mathematics, Narosa Publishing House, 2002.
2. Erwin Kreyszig; Advanced Engineering Mathematics, John Wiley & Sons, 1962.
3. R.V. Churchill and J.L. Brown, Complex Variables and Applications, McGraw Hill, 1990.
4. B.S.Grewal, Higher Engineering Mathematics, Khanna Publisher, 2005.
5. J.H. Mathews and R.W. Howell, Complex analysis for Mathematics and Engineering, 3rd Ed. Narosa, 1998.

Course Objective :

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

STRENGTH OF MATERIALS (BME-301) L T P C 3 1 2 5

Prerequisite: Students must have knowledge of engineering mechanics engineeringbasic application

Course Outcomes:

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

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

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

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

CO4 To understand the basic concept of combined and direct bending stress analysis and design of structural elements such as columns and strut.
CO5 Analysis the tihck and thin cylindrical

Course Content:

Unit I
Stresses in Beams: Review of pure Bending**.** Direct and shear stresses in beams due to transverse and axial loads, composite beams.

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

Unit II
Unsymmetrical Bending: Properties of beam cross-section, slope of neutral axis, stress and deflection in unsymmetrical bending, determination of shear center and flexural axis (for symmetry about both axis and about one axis) for I-section and channel section.
Deflection of Beams: Shear Force and Bending Moment Diagram, Flexuralrigitidit**,** Equation of elastic curve, cantilever and simply supported beams, Macaulay's method, area moment method Fixed beams. Castigliano‘s Theorem

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

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

Unit V
Thin cylinders & spheres: Hoop and axial stresses and strain. Volumetric strain.
Thick cylinders: Radial, axial and circumferential stresses in thick cylinders subjected to internal or external pressures, Compound cylinders Stresses due to interference fits.

Text and Reference Books:

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

BUILDING MATERIALS & CONSTRUCTION (BCE 301)

LTPC 3 0 2 4

Course Outcomes:

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

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

Unit-I

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

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

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

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

Lime: IS specifications, field tests of limes.

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

Glass: Types and uses

Unit-II

Building Materials: Cement, Admixtures, Aggregate& Mortar

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

characteristics, composition, use and properties, tests on cements

Admixtures: Mineral admixtures, chemical admixtures

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

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

Modern Building Materials

Unit-III

Building Construction: Masonry Works &Building Byelaws

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

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

Unit-IV

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

Foundation: Types of foundation and selection criteria

Floor : Types of floors, construction details and selection criteria

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

Stairs : Types of stairs, materials, proportions

Lifts and escalators: Utilities and types

Unit-V

Building Construction: Doors, Windows, Finishes & Building Protections

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

painting, distempering

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

BUILDING MATERIALS & CONSTRUCTION LAB (BCE 351)

List of Experiments

1. Cement

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

2. Coarse Aggregate

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

3. Fine Aggregate

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

4. Bricks

- Water absorption
- Dimensional tolerances

- Compressive strength
- Efflorescence

5. Physical and mechanical properties of reinforcing steel

References:

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

SURVEYING-I (BCE 303)

L T P C 3 1 2 5

Course Outcomes:

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

CO1 Understand the working principles of survey instruments

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

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

CO4 Calculate angles, distances and levels.

CO5 Assess errors and apply corrections

Unit-I Introduction

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

Measurement of Distances

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

Unit-II

Measurements of Angles and Directions

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

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

Unit-III Traversing

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

Tacheometry

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

Unit IV

PlaneTable Surveying

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

Unit-V

Measurements of Elevation and Contouring

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

SURVEYING-I LAB (BCE 352)

List of Experiments

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

and fall method).

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

References :

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

BCE – 302 WATER RESOURCES ENGINEERING

L T P C 3-0-0-3

Course Outcomes:

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

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

CO2 Demonstrate the stream flow measurement.

CO3 Apply fundamental concept of mathematics to obtain hydrograph characteristics.

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

CO5 Understand solution regarding water logging and drainage.

UNIT – I

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

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

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

UNIT – II

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

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

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

UNIT – III

Sediment Transportation: Suspended and Bed load and its estimation

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

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

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

UNIT – IV

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

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

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

UNIT – V

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

Text Book

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

References

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

ENVIRONMENT AND ECOLOGY (MC 301/ MC 401)

2 0 0 0

L T P C

COURSE OUTCOMES:

On completion of this course, students will be able to

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

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

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

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

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

UNIT-II: Impact of Human Activity on Environment Human Population and Environment – Population growth, population explosion and migration; Impact of farming, housing, mining, transportation and industrial growth Social Issues Related to Environment– Sustainable development, urban problems (related to water and energy conservation and waste management), resettlement and rehabilitation Environmental ethics

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

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

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

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

Registrar:RAJEEV KUMAR
Signing Date:14.06.2024
02:26

UNDERGRADUATE DEGREE COURSE

Bachelor of Engineering

IV Semester

Civil Engineering

Institute of Engineering & Technology, Khandari Campus

Dr. B R Ambedkar University, Agra

Effective from session: 2019-20

Registrar:RAJEEV KUMAR
Signing Date:14.06.2024
02:26

ENGINEERING FLUID MECHANICS - I (BCE 401)

L T P C 3 1 2 5

Course Outcome:

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

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

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

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

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

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

UNIT-I

Introduction:

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

Fluid Statics:

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

UNIT-II

Fluid Kinematics:

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

UNIT-III

Fluid Dynamics:

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

Mouthpieces, Concept of HGL & TEL.

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

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

UNIT-IV

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

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

Unit-V

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

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

ENGINEERING FLUID MECHANICS LAB (BCE 451)

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

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

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

References:

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

DISASTER MANAGEEMNT

L T P C

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.

2 0 0 2

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

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

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

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

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

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

Text/Reference Books:

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

STRUCTURAL ANALYSIS-I (BCE 403) **L T P C 3 1 0 4**

Course Outcomes:

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

CO1 Understand the concept of determinate and indeterminate structure.

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

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

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

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

UNIT-I

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

UNIT-II

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

UNIT-III

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

UNIT-IV

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

UNIT-V

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

ESTIMATING & COSTING

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

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

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

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

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

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

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

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

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

Text/Reference Books:

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

On completion of the course, the students will:

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

BCE 404 GEOTECH ENGINEERING

L T P C

3 0 0 3

Course Outcomes:

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

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

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

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

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

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

UNIT – 1

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

UNIT – 2

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

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

UNIT – 3

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

UNIT – 4

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

UNIT – 5

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

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

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

Text & References Books

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

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

GEOTECH ENGINEERING LAB (BCE 454)

Course Outcomes:

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

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

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

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

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

Human Values and Professional Ethics (MC 402/MC 302)

Course Objective

LTPC
2000

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

Course Outcome

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

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

UNIT-1

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

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

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

UNIT-3

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

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

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

Text Books:

References:

1. R R Gaur, R Sangal, G P Bagaria, 2009, A Foundation Course in Human Values and Professional Ethics.
2. A Nagraj, 1998, Jeevan Vidya Ek Parichay, Divya Path Sansthan, Amarkantak
3. R. Subramanian,2017, Professional Ethics,
4. P L Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Publishers.
5. A N Tripathy, 2003, Human Values, New Age International Publishers.
6. SubhasPalekar, 2000, How to practice Natural Farming, Pracheen (Vaidik) KrishiTantraShodh, Amravati.
7. E G Seebauer & Robert L. Berry, 2000, Fundamentals of Ethics for Scientists & Engineers , Oxford University Press.
8. M Govindrajran, S Natrajan & V.S. Senthil Kumar, Engineering Ethics (including Human Values), Eastern Economy Edition, Prentice Hall of India Ltd.
9. B P Banerjee, 2005, Foundations of Ethics and Management, Excel Books.
10. B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008.

Syllabus of

UNDERGRADUATE DEGREE COURSE

Bachelor of Engineering

V Semester

Civil Engineering

Institute of Engineering & Technology, Khandari Campus

Dr. B R Ambedkar University, Agra

Effective from session: 2020-21

PCC	ENVIRONMENTAL ENGINEERING	BCE 501	3 1 0	4 CREDITS
COURSE OUTCOMES:				
CO1	Analyze characteristics of water and wastewater			
CO2	Estimate the quantity of drinking water and domestic wastewater generated			
CO3	Design components of water supply systems			
CO4	Design sewerage system.			
CO5	Design of waste water filtration plants.			

Unit-1

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

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

Unit-2

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

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

Unit-3

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

Unit-4

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

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

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

Disinfection: requirements of an ideal disinfectant; various disinfectants, chlorination and practices of chlorination, water softening and ion-exchange process

Unit-5

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

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

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

Text Books:

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

References:

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

9. Kshirsagar: Water Supply and Treatment and Sewage Treatment Vol. I and II
10. Punmia: Water Supply and Wastewater Engineering Vol. I and II

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

1. Determination of pH.

2. Determination of Conductivity.

3. Determination of Acidity of water.

4. Determination of Alkalinity of Water.

5. Determination of Chlorides.

6. Determination of Hardness of water.

7. Determination of Fluorides.

8. Determination of Available Chlorine in bleaching powder.

9. Conducting Break Point Chlorination Test.

10. Determination of Residual Chlorine.

11. Determination of Dissolved Oxygen.

12. Determination of Chemical Oxygen Demand.

13. Determination of Biochemical Oxygen Demand.

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

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

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

Unit I

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

Unit-II

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

Unit-III

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

Unit IV

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

Unit-V

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

Course outcomes:

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

References:

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

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

List of Experiments

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

PCC	STRUCTURAL ANALYSIS-II	BCE 503	3 1 0	4 CREDITS

COURSE OUTCOMES:	
CO1	Demonstrate the concepts of qualitative influence line diagram for continuous beams and frames.
CO2	Analyze of Continuous beam & Frame by Moment-Distribution Method.
CO3	Analyze of Vertical & Horizontal loads by Approximate Method.
CO4	Identify Plastic analysis of beams & frames.
CO5	Apply the methods of indeterminate truss analysis.

Unit-I

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

Unit II

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

Unit-III

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

Unit IV

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

Unit V

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

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

List of Experiments

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

References :

- Wilbur and Norris, –Elementary structural analysis|, Tata McGraw Hill.
- Reddy, C.S., –Basic structural analysis|, Tata McGraw Hill.

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

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

Unit I

Occupational Health:

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

Unit II Safety

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

Unit III

Accident Causes and prevention:
Causation, Accident problem, Reasons for prevention, factors impending safety, Accident prevention

Safety Management:

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

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

Unit IV

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

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

Unit V

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

Syllabus of

UNDERGRADUATE DEGREE COURSE

Bachelor of Engineering

VI Semester

Civil Engineering

Institute of Engineering & Technology, Khandari Campus

Dr. B R Ambedkar University, Agra

Effective from session: 2020-21

HSMC	**ECONOMICS FOR INDUSTRY**	**HSMC 601**	**2 0 0**	**2 CREDITS**
COURSE OUTCOMES:				
CO1	Define the main concepts and describe the models and methods in economic analysis			
CO2	Explain economic events in individual markets and the aggregate economy using basic theory and tools			
CO3	Apply supply and demand analysis to relevant economic issues			
CO4	Explain how individual decisions and actions as a member of society affect the economy locally, nationally and internationally			

CO5	Distinguish between perfect competition and imperfect competition and explain the welfare loss in non-competitive markets

Unit 1

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

Unit 2

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

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

Unit 3

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

Unit 4

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

Unit 5

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

PCC	**HYDRAULIC AND HYDRAULIC MACHINES**	**BCE 601**	**3 1 0**	**4 CREDITS**
COURSE OUTCOMES:				
CO1	Understanding the Computation of drag and lift coefficients			
CO2	Analyzing channels for design			
CO3	Understanding flow profiles in channel transitions and analyze hydraulic transients			

CO4	Evaluating the working proportions of hydraulic machines
CO5	Analyzing compressible flows of liquids and gases

Unit-I

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

Unit-II

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

Unit-III

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

Unit-IV

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

Unit-V

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

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

LC	**HYDRAULIC & HYDRAULIC MACHINES LAB**	**BCE 651**	**0 0 2**	**1 CREDIT**
COURSE OUTCOMES:				

CO1	Determine Manning's and Chezy's coefficients for smooth and rough channels
CO2	Understand the velocity distribution in an open channel flow.
CO3	Understand the various characteristics of pump.
CO4	Determine the coefficient of discharge for notches.
CO5	Interpret the lab results keeping in mind the real life scenarios

List of Experiments

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

References:

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

PCC	TRANSPORTATION ENGINEERING	BCE 602	3 1 0	4 CREDITS

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

UNIT-1

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

UNIT-2

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

UNIT-3

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

UNIT-4

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

UNIT-5

Highway Construction: Construction of Subgrade, Water Bound Macadam (WBM), Wet mix macadam (WMM), Granular Sub Base (GSB),Tack Coat, Prime Coat, Seal Coat, Surface Dressing, Bituminous Macadam (BM), Semi dense bituminous concrete (SDBC) and Bituminous

concrete, Dry lean concrete (DLC), Cement Concrete (CC) road construction, Roller Compacted Concrete Roads.

Text Book:

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

References:

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

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

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

1. To Determine the Crushing Value of Coarse Aggregates.
2. To Determine the Impact Value of Coarse Aggregates.
3. To determine the Flakiness Index and Elongation Index of Coarse Aggregates.
4. To determine the Los Angeles Abrasion Value of Coarse Aggregates.
5. To determine the Stripping Value of Coarse Aggregates.
6. To determine the penetration Value of Bitumen.
7. To determine the Softening Point of Bituminous material.
8. To determine the Ductility Value of Bituminous material.
9. To determine the Flash and Fire Point of Bituminous material.

10. To determine the Stripping Value of Bituminous material.
11. Classified both directional Traffic Volume Study.
12. Traffic Speed Study. (Using Radar Speedometer or Endoscope).
13. Determination of CBR Value of soil sample in the Lab or in Field.

LC	CAD LAB	BCE 651	0 0 6	3 CREDIT
COURSE OUTCOMES:				
CO1	Identify the available open source software tools used for specific problems in Civil Engineering.			
CO2	Use the latest software tools for Modeling, Analysis and Design of Civil Engineering Systems.			

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

Syllabus of

UNDERGRADUATE DEGREE COURSE

Bachelor of Engineering

VII Semester

Civil Engineering

Institute of Engineering & Technology, Khandari Campus

Dr. B R Ambedkar University, Agra

Effective from session: 2021-22

PCC	CONSTRUCTION PLANNING & MANAGEMENT	BCE 701	3 0 0	3 CREDITS
COURSE OUTCOMES:				
CO1	Understand the modern management techniques like as CPM/PERT with network analysis.			
CO2	Identify the equipment used in construction			
CO3	Prepare tender and contract document for a construction project			
CO4	Understand & specify the public work accounts.			
CO5	Prepare schedule of activities in a construction project			

Unit -I

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

Unit -II

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

Unit -III

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

Unit -IV

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

Unit-V

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

Reference Books:-

1. Construction Equipment by Peurify
2. CPM by L.S. Srinath
3. Construction Management by S. Seetharaman
4. CPM & PERT by Weist & Levy
5. Construction, Management & Accounts by Harpal Singh
6. Tendering & Contracts by T.A. Talpasai

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

Unit - 1

Introduction: Objective, scope and outcome of the course.

Fundamental concepts of design of RC members, assumptions. Types and function of reinforcement. Introduction to various related IS codes, Characteristic load and characteristic strength.

Working Stress Method: Working stress design philosophy. Analysis and Design of singly reinforced rectangular beam section for flexure.

Unit 2

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

Unit 3

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

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

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

Unit 4

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

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

Unit 5

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

Reference Books/ Text Book / Cases:

- Dayaratnam P. Limit State Design of Reinforced Concrete Structures New Delhi: Oxford Publishers; 2008.
- GambhirM.L Fundamentals of Reinforced Concrete Design New Delhi: PHI Publisher; 2009.
- IS: 456:2000 Plain and Reinforced Concrete - Code of Practice New Delhi: Bureau of Indian Standards.
- Krishna Jai Plain and Reinforced Concrete Vol.1 Roorkee: Nem Chand Brothers;2007.
- Jain A.K. Reinforced Concrete: Limit State Design Roorkee: Nem Chand and Brothers; 2007.

- Krishna Raju N. Pre stressed Concrete New Delhi: Tata Mc Graw Hill; 2007.
- Menon D .and Pillai, S. Reinforced Concrete DesignNew Delhi: Tata Mc Graw Hill; 2007.

Syllabus of
UNDERGRADUATE DEGREE COURSE

Bachelor of Engineering

VIII Semester

Civil Engineering

Institute of Engineering & Technology, Khandari Campus

Dr. B R Ambedkar University, Agra

Effective from session: 2021-22

PCC	DESIGN OF STEEL STRUCTURE	BCE 801	3 1 0	4 CREDITS
COURSE OUTCOMES:				
CO1	Understand the advantages and disadvantages of steel as a structural material.			
CO2	Create simple bolted and welded connections.			
CO3	Analyze and design Tension members, Compression members, Flexural members.			
CO4	Analyze & Design of Beams & Columns.			
CO5	Analyze & Design of Girder.			

Unit I

Introduction: Objective, scope and outcome of the course.

Types of Steels and their broad specifications.

Structural steel forms- hot rolled, tubular, light gauge etc and their applicability.

Classification of cross sections as per IS 800-2007- Plastic, compact, semi compact and slender- characteristics

Unit II

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

Connections: Types of bolts, load transfer mechanism, prying action.

Design of bolted and welded connections under axial and eccentric loadings with IS Provisions

Unit III

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

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

Unit IV

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

Member design under combined forces: Compressive load and uniaxial moment. tension and uniaxial moment

Column Bases: Design of column bases for axial and eccentric

Compressive loads: Slab and gusseted base.

Unit V

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

Design of gantry girder

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

References:

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

DEPARTMENTAL ELECTIVE – I

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

CO5	Understand the waste water disposal.

Unit I

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

Introduction to Wastewater treatment and Design

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

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

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

Unit II

Wastewater Treatment

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

Unit III

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

Unit IV

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

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

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

Unit V

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

References:

1. Sewage Disposal and Air Pollution Engineering, by S.K Garg, Khanna Publishers, 2012Wastewater Engineering and Treatment, Disposal, and Reuse by Metcalf and Eddy,

Tata McGraw Hill Education
2. Environmental Engineering by H.S. Peavy, Rowe and Tchobanoglous, Tata McGraw Hill Education
3. Wastewater treatment: Concepts and design approach by G.L. Karia and R.A. Christian, Prentice Hall of India private ltd, New Delhi.

PEC	WATER QUALITY MODELING	DE-CE 502	3 0 0	3 CREDITS
COURSE OUTCOMES:				
CO1	Understand the river hydrology and flow.			
CO2	Understand the quality distribution of water.			
CO3	Identify the physical & hydrological characteristics of lake.			

CO4	Understand the sources & sinks of dissolved Oxygen.
CO5	Introduction to water quality model. Understand about ground water.

Unit I

Introduction: Nature of problem, nature of input, mass loading rates-point and intermittent.
River hydrology and flow: low flow frequency analysis, Morphometry (hydraulic geometry), travel time, depth and velocity estimates.
Discharge of residual matter into rivers: Assumptions, mass balance at discharge points, water quality downstream of point source, water quality response to distributed sources, effect of spatial flow variation on water quality, multiple sources-principles of superposition.
Engineering controls; Derivation of steady state stream equations

Unit II

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

Unit III

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

Unit IV

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

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

Unit V

Ground water: Subsurface processes, unsaturated zone properties, soil moisture level, flow through unsaturated porous media.
Ground water contamination: sources and causes, hydrodynamic dispersion, multiphase contamination DNAPL, NAPL, VOC, site specific ground water quality problems in India, numerical models, contaminant transport modeling
Introduction to water quality models: QUAL2E, QUAL2K, WASP4, MODFLOW, GMS.

References :

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

PEC	**PLASTIC ANALYSIS OF STRUCTURES**	**DE-CE 503**	**3 0 0**	**3 CREDITS**

COURSE OUTCOMES:	
CO1	Understand the characteristics of Plastic.
CO2	Analyze the beam & frames.
CO3	Understand the Semi graphical and mechanism method.
CO4	Understand the plastic moment distribution.
CO5	Understand the effect of axial force and shear force.

Unit I

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

Unit II

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

Unit III

Semi Graphical method and Mechanism method.

Unit IV

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

Unit V

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

Books:

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

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

Unit I

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

Unit II

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

Unit III

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

Unit IV

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

Unit V

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

References:

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

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

Unit I

Hydrologic cycle: Hydrologic cycle, water budget equation.

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

Unit II

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

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

Unit III

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

Unit IV

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

Unit V

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

Flood Routing: : Introduction and categories, Hydrologic and Hydraulic Routing, Hydraulic channel Routing, Muskingam Method, Hydrologic storage routing, Modified Puls Method, Good rich Method.

References:

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

DEPARTMENTAL ELECTIVE – II

PEC	PLANNING AND MANAGEMENT OF BUILDINGS	DE-CE 601	3 0 0	3 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.			

Unit I

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

Unit II

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

Unit III

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

Unit IV

Standard fire, fire list, fire resistance, classification of buildings, means of escape, alarms. Fire

hydrants, design criteria of fire hydrant system

Unit V

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

References:

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

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

Unit I

Introduction: Objective, scope and outcome of the course

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

Unit II

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

Unit III

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

Unit IV

Earthquake Load Analysis: Earthquake loads & calculations of earthquake loads on

framed structures. (IS: 1893 – Part 1).

Unit V

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

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

Unit-1

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

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

Unit-2

Rural Sanitation: Introduction to rural sanitation- Community and sanitary latrines - Planning of wastewater collection system in rural areas- Treatment and Disposal of wastewater - Compact and simple wastewater treatment units and systems in rural areas stabilization ponds - septic tanks -

Imhoff tank- soak pits- low cost excreta disposal systems Effluent disposal. Identify problems pertaining to rural water supply and sanitation. Design water supply and sanitation system for rural community.

Unit-3

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

Unit-4

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

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

References:

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

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

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

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

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

PEC	COMPUTER AIDED STRUCTURAL ENGINEERING	DE-CE 604	3 0 0	3 CREDITS

COURSE OUTCOMES:	
CO1	Apply the computer in design.
CO2	Analyze the beam using stiffness method.
CO3	Understand database.
CO4	Understand the MATLAB software & applying its application.
CO5	Understanding the various software for design of structure.

Unit I

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

Unit II

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

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

Unit III

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

Unit IV

Introduction to MATLAB and its application

Unit V

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

References :

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

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

Unit I

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

Unit II

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

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

Unit III

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

Unit IV

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

Unit V

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

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

References:

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

DEPARTMENTAL ELECTIVE –III

PEC	PRE STRESSED CONCRETE DESIGN	DE-CE 701	3 0 0	3 CREDITS
COURSE OUTCOMES:				
CO1	Understand the basic properties of pre-stressed concrete constituents.			
CO2	Analyze the flexural behavior of simple and composite pre-stressed concrete girders.			

CO3	Design the prestressed concrete sections.
CO4	To acquire knowledge in knowing Analysis for stress of composite pre-stressed concrete girders for flexure using limit state design procedures
CO5	Understand the optimization techniques & apply on prestressed concrete structure.

Unit I

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

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

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

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

Unit II

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

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

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

Unit III

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

Unit IV

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

Unit V

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

References:

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

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

UNIT – I

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

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

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

UNIT – II

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

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

UNIT – III

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

Investigation and planning of dams and Reservoirs: Zones of storage, Estimation of storage capacity, Reservoir losses, Reservoir sedimentation and its control, life of a reservoir. Dams: classification and selection criteria.

Earth Dams: Classification, causes of failure Phreatic line, and its determination Introduction to stability analysis.

UNIT – IV

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

UNIT – V

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

Text Books

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

References

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

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

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

Unit I

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

Unit II

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

Unit III

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

Unit IV

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

Unit V

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

References:

1. AdibKanafani.(1983). Transportation Demand Analysis. Mc Graw Hill Series in Transportation, Berkeley.
2. Hutchinson, B.G. (1974). Principles of Urban Transport Systems Planning. Mc Graw Hill

Book Company, New York.
3. John W.Dickey. (1975). Metropolitan Transportation Planning. Mc Graw Hill Book Company, New York.
4. Papacostas, C.S., and Prevedouros, P.D. (2002). Transportation Engineering and Planning. 3rd Edition, Prentice - Hall of India Pvt Ltd., 318-436

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

Unit I

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

Unit II

Standard specifications for road and railway bridges.

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

Unit III

Steel Bridges: Plate girder and truss bridges

Unit IV

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

Unit V

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

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

References :

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

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

Unit - I

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

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

Unit II

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

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

Unit III

Strong ground motion: Introduction, Strong motion observation studies, strong motion

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

Unit IV
Dynamic soil testing techniques: cyclic plate load test, block vibration test, shear modulus test, geophysical methods, Resonance- column test, Two & three borehole techniques, Model tests using centrifuge and shake table, recent developments
Vibration isolation and control: vibration transmitted through soil media, active and passive isolation, vibration isolation – rigid foundation and flexible foundation, method of isolation, properties of material and media used for isolation, vibration control of existing machine, foundation isolation by barriers.

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

References :

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

DEPARTMENTAL ELECTIVE –IV

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

Unit -I

Equivalent Single Wheels Load concepts and applications, Relationship between wheel arrangements and loading effects, tyre contact area, Effect of load repetition, Effect of transient

loads, Impact of moving loading, Factors to be considered in Design of pavements, Design wheel load, soil, climatic factors, pavement component materials, Environmental factors, Special factors such as frost, Freezing and thawing.

Unit -II

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

Unit -III

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

Unit -IV

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

Unit -V

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

Reference Books:--

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

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

Unit I

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

Unit II

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

Unit III

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

Unit IV

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

Unit V

Sediment properties

Incipient sediment motion of uniform and non-uniform sediments, stable channel design Flow resistance and bed form regimes Bed loads, suspended loads and total load, Sediment sampling, stable channel design, sediment control, aggradation, degradation, sediment discharge,Local scour around hydraulic structure and scour protection

Reference:

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

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

CO4	Understand the quality& exploration of ground water.
CO5	Understand the Ground water management techniques.

Unit-1
Introduction, hydrological cycle & definitions, Occurrence of ground water, hydro-geology & aquifers, Ground water movement, Darcy's law, flow-nets in isotropic medium.

Unit-2
Steady and unsteady flow through confined and unconfined aquifers, Dupuits theory, Observation wells, Well Hydraulics: Single& Multiple well system, partially penetrating wells, Image wells, Mutual interference of wells, well losses, specific capacity, Inverse problem i.e. pumping tests for aquifer parameters.

Unit-3
Water Wells: Design of water wells, Well construction, Well completion, Development of wells Pumping equipment for water wells, maintenance of wells, ground water irrigation.

Unit-4
Ground Water quality, Contamination of groundwater and its Control, Ground Water Modeling Techniques, Ground water exploration, Surface and Subsurface Investigations of Ground water, Artificial discharge and Recharge of Ground Water, Groundwater drainage.

Unit-5
Ground Water Management Techniques: Groundwater budgeting, groundwater modeling & stimulation, application of GIS and remote sensing in groundwater management. roof-top rainwater harvesting and recharge.

Recommended References:

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

PEC	**DESIGN OF MASONRY, TIMBER AND ALUMINIUM STRUCTURES**	**DE-CE 804**	**3 0 0**	**3 CREDITS**
COURSE OUTCOMES:				
CO1	Able to design the walls and columns with and without eccentricity			
CO2	Understand the stability of masonry dams and retaining walls			

CO3	Familiarize in the basic concepts of limit state design
CO4	Gain knowledge in design of timber structures
CO5	Know the purpose, procedures for the connections in Aluminum structures

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

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

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

Unit IV
TIMBER STRUCTURES
Factors affecting the strength – permissible stresses – Design for bending, shear and bearing - Flitched beams – solid and built up columns – combined bending and direct stress – application to form work.
Unit V
ALUMINIUM STRUCTURES
Introduction, Stress-Strain Relationship - Permissible Stresses - Tension and Compression Members, Laced and Battened Columns, Beams, Riveted and Bolted Connections.
TEXT BOOK
1. Arya A.S., Structural Design in Steel, Masonry and Timber, Nemchand and Bros., Roorkee, 1987.
REFERENCE BOOK
1. Dayarathnam P., Bricks and Reinforced Brick Structures, Oxford & IBH Publishing Co., New Delhi, 2000.

PEC	MATRIX METHOD OF STRUCTURAL ANALYSIS	DE-CE 805	3 0 0	3 CREDITS
COURSE OUTCOMES:				
CO1	Understand about the structures.			

CO2	Understand the Mathematical preliminaries and Trusses.
CO3	Analyze the beams.
CO4	Analyze of plane frames.
CO5	Understand Finite element method.

Unit I

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

Review of analysis of indeterminate structures: Force and displacement methods

Unit II

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

Analysis of Trusses

Unit III

Analysis of Beams

Unit IV

Analysis of plane frames

Implementation issues

Unit V

Beyond matrix method: Introduction to finite element method

References:

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

DEPARTMENTAL ELECTIVE –V

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

Unit I

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

Unit II

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

Unit III

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

Unit IV

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

Unit V

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

References:

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

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

Unit I

Introduction: Objective, scope and outcome of the course.

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

Unit II

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

Unit III

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

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

Unit IV

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

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

Unit V

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

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

References

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

PEC	DOCKS AND HARBOUR ENGINEERING	DE-CE 808	3 0 0	3 CREDITS

COURSE OUTCOMES:	
CO1	To understand the various elements of Harbour Engineerimg.
CO2	To understand the natural phenomena of Harbour Engineering.
CO3	To understand the fundamentals of planning and design of various marine structures
CO4	To understand the Docks & Locks.
CO5	To understand the Port amenities & Navigational Aids.

Unit I

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

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

Unit II

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

Unit III

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

Unit IV

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

Unit V

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

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

Reference Books:

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

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

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

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

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

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

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

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

Recommended References:
1. Industrial Wastewater Management Handbook, Azad, Hardom Singh, Editor-in-Chief, McGraw Hill, New York.

2. Wastewater Reuse and Recycling Technology-Pollution Technology Review-72, Culp, Gordan, George Wasner, Robert Williams and Mark , V.Hughes Jr., Noyes Data Corporation, New Jersey.
3. The Treatment of Industrial wastes. Edmund, B. Besselieve P.E., McGraw Hill, New York.
4. Industrial Pollution Control –Issues and Techniques. Nancy, J. Sell, Van Nostrand Reinhold Co, NY.
5. Wastewater Engineering: Treatment & Re-use. Metcalf & Eddy, Tata Mc Graw-Hill.
6. Industrial Pollution Prevention Handbook. Shen, T.T., Springer-Verlag, Berlin.
7. Environmental Engineering. Pandey, G.N. and Corney, G.C., Tata McGraw Hill, New Delhi
8. Environment (protection) Act- 1986. Any authorized & recent publication on Government Acts.
9. Industrial Pollution Control and Environmental Audit by Sanjay Gupta

PEC	EARTHQUAKE RESISTANT DESIGN SYSTEMS	DE-CE 810	3 0 0	3 CREDITS

COURSE OUTCOMES:	
CO1	Understand the basic concepts on theory of Engineering Seismology.
CO2	Analyze of Single & Multi degree of freedom.
CO3	To Acquire knowledge in knowing the performance of buildings under past earthquakes.
CO4	Understand the underground water Sources.
CO5	To get knowledge on earthquakes and its resistant features for different types of buildings.

Unit I

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

Unit II

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

Unit III

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

Unit IV

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

Unit V

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

References :

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

OPEN ELECTIVE – I

OEC	ENVIRONMENTAL POLLUTION & MANAGEMENT	OE-CE 501	3 0 0	3 CREDITS

COURSE OUTCOMES:	
CO1	Identify the impact of human on environment.
CO2	Identify the water & thermal pollution sources. Apply the prevention of its causes.
CO3	Identify the noise, land & air pollution sources. Apply the prevention of its causes.
CO4	Apply the EIA
CO5	Identify the contemporary issues.

Unit 1

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

Unit II

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

Unit III

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

Unit IV

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

Unit V

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

References :

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

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

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

UNIT-I

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

UNIT-II

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

UNIT-III

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

UNIT-IV

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

UNIT-V

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

Reference Books:-

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

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

OE-EC 501 Laser Systems and its Application

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

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

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

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

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

Unit-5 (8 Hrs)

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

Text/ Reference Books:

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

OE-EC 502 Bio-Medical Engineering

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

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

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

Unit-1 (10 Hrs)

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

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

Unit-2 (8 Hrs)

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

Unit-3 (7 Hrs)

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

Unit-4 (10 Hrs)

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

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

Unit-5 (11 Hrs)

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

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

Text/Reference Books:

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

Industrial Engineering and Automation (OE-ME-501)

L T P C
3 0 0 3

Prerequisite: Basic Knowledge of Workshop Practice.

Course Outcomes (COs):

After completing this course a student will be able to:

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

Course Contents:

Unit I

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

Unit II

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

Unit III

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

Unit IV

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

Unit V

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

Textbooks:

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

Reference Books:

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

Total Quality Management (OE-ME-502)

L T P C
3 0 0 3

Prerequisite: Basic Knowledge of Industrial Engineering

Course Outcomes (COs):

After completing this course a student will be able to:

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

Course Contents:

Unit I

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

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

Unit II

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

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

Unit III

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

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

Unit IV

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

Unit V

IS0 and its concept of Quality Management: Quality systems, need for ISO 9000, ISO 9001-9008; Quality system- elements,documentation, Quality auditing, QS 9000, ISO 14000- concepts, requirements and benefits; TQM implementation in manufacturing and service sectors, Auditing, Taguchi method, JIT in some details.

Textbooks:

1. Total Quality Management by Mukherjee, P.N.
2. Janakiraman B. and Gopal R.K., Total Quality Management, Prentice Hall India, 2006.
3. Total Quality Management, by Dale H. Bester field, Pearson India.

Reference books:

1. Beyond Total Quality Management, Greg Bounds, McGraw Hill.
2. Bester field D.H. et al., Total quality Management, 3rd ed., Pearson Education Asia, 2006.
3. Evans J.R. and Lindsay W.M., The management and Control of Quality, 8th ed., first Indian edition, Cengage Learning, 2012.
4. Suganthi L. and Samuel A., Total Quality Management, Prentice Hall India, 2006.
5. TQM in New Product manufacturing, H. G. Menon, McGraw Hill.

Production Planning and Control (OE-ME-503)

L T P C

3 0 0 3

Prerequisite:

Course Outcomes (COs):

After completion of this course student will be able to:

1. Understand the role Production Planning and control activities in Manufacturing and Services.
2. Understand and perform various Forecasting techniques and problems.
3. Understand and perform various Inventory Management techniques and apply in real manufacturing scenario/How to use MRP/ERP.
4. Demonstrate various Scheduling procedures/Balancing concepts.
5. Understand and Evaluate Dispatching procedures.

Course Contents:

UNIT I

Introduction: Definitions – objectives of production planning and control functions of production planning and control-elements of production control types of production- organization of production planning and control – internal organizations department.

UNIT II

Forecasting: Importance of forecasting – types of forecasting, their uses general principles of forecasting techniques- Qualitative methods and quantitative methods.

UNIT III

Inventory management: Functions inventory- Relevant inventory cost- ABC analysis- VED Analysis- EOQ model – Inventory control systems – P- Systems and Q – Systems Introduction to MRP and ERP, LOB (Line of balance), JIT inventory, Japanese concepts.

UNIT IV

Routing: Definition **–** routing procedure- Route sheets – Bill of material factors affecting routing procedure.Schedule – definition – difference with loading. Scheduling polices – techniques, standard scheduling methods- job shop, flow shop, Line balancing, aggregate planning- methods for aggregate planning- Chase planning, expediting, control aspects.

UNIT V

Dispatching: Activities of dispatcher- Dispatching procedure - follow up – definition – reasons for existence of functions – types of follow up, applications of computer in production planning and control

Textbooks:

1. K C Jain and L N Agarwal, Production Planning and Control, 6th edition, Khanna Publishers, 2008.
2. M Mahajan, Production Planning and Control, Dhanpat Rai & Co., 2010.

Reference Books:

1. R Paneerselvam, Production & Operations Management, 2nd edition, PHI Publications, 2006.
2. E S Baffa and R K Sarin, Modern Production & Operation Managements, 8th edition, Wiley Publications, 2009.
3. O P Khanna, Industrial Engineering and Management, Dhanpat Rai & Co., 2009.
4. Samuel Eilon, Elements of Production Planning and Control, The Macmillan Company, New York.
5. S D Sharma, Operations Research, KedarnathRamnath Publishers, 1996.
6. J K Sharma, Operations Research, 4th edition, Macmillan India Limited, 2009.
7. P Ramamurthy, Production and Operations Management, New Age International Publications, 2007
8. K L Narayana, P Kannaiah and K Venkata Reddy, Machine Drawing, 3rd edition, New Age Publications, 2006.

Value Engineering (OE-ME-504)

L T P C

3 0 0 3

Prerequisite:

Course Outcomes (COs):

After completing this course a student will be able to:

1. Understand concepts of value engineering and value analysis.
2. Understand the evaluation techniques of function and problem setting and solving systems.
3. Describe various phases involved in value engineering job plan and techniques of value engineering.
4. Understand the applications of value Analysis of management practice in different organizations.
5. Demonstrate their ability to apply value analysis in various fields.

Course Contents:

UNIT I

Introduction to value analysis: Definition of Value, Value Analysis, Value Engineering, Value management, Value Analysis versus Value Engineering, Value Analysis versus Traditional cost reduction techniques, uses, applications, advantages and limitations of Value analysis. Symptoms to apply value analysis, Coaching of Champion concept.

Type of values: Reasons for unnecessary cost of product, peeling cost Onion concept, unsuspected areas responsible for higher cost, Value Analysis Zone, attractive features of value analysis. Meaning of Value, types of value & their effect in cost reduction. Value analysis procedure by simulation.Detailed case studies of simple products.

UNIT II

Functional cost and its evaluation: Meaning of Function and Functional cost, Rules for functional definition, Types of functions, primary and secondary functions using verb and noun, Function evaluation process, Methods of function evaluation. Evaluation of function by comparison, Evaluation of Interacting functions, Evaluation of function from available data, matrix technique, MISS technique, Numerical evaluation of functional relationships and case studies.

Problem setting & solving system: A problem solvable stated is half solved, Steps in problem setting system, Identification, Separation and Grouping of functions. Case studies.

Goods system contains everything the task requires. Various steps in problem solving, case studies.

UNIT III

Value engineering job plan: Meaning and Importance of Value Engineering Job plan. Phases of job plan proposed by different value engineering experts, Information phase, Analysis phase, Creative phase, Judgments phase, Development planning phase, and case studies. Cost reduction programs, criteria for cost reduction program, Value analysis change proposal.

Value engineering techniques: Result Accelerators or New Value Engineering Techniques, Listing, Role of techniques in Value Engineering, Details with Case examples for each of the techniques.

UNIT IV

Advanced value analysis techniques: Functional analysis system technique and case studies, Value Analysis of Management Practice (VAMP), steps involved in VAMP, application of VAMP to Government, University, College, Hospitals, School Problems etc., (service type problems).

Unit V

Total value engineering: Concepts, need, methodology and benefits.

Application of value analysis: Application of Value analysis in the field of Accounting, Appearance Design, Cost reduction, Engineering, manufacturing, Management, Purchasing, Quality Control, Sales, marketing, Material Management Etc., Comparison of approach of Value analysis & other management techniques.

Textbooks:

1. Techniques of Value Analysis and Engineering – Lawrence D. Miles - McGraw Hill Book Company - 2nd Edition.
2. Value engineering for Cost Reduction and Product Improvement – M.S. Vittal – Systems Consultancy Services – Edn.1993.
3. Value Management, Value Engineering and Cost Reduction – Edward D Heller – Addison Wesley Publishing Company-1971.

Reference books:

1. Value Analysis for Better Management – Warren J Ridge – American Management Association - Edition1969.
2. Getting More at Less Cost (The Value Engineering Way) – G. Jagannathan - Tata McGraw Hill Pub. Comp Edition1995.
3. Value Engineering – Arther E Mudge - McGraw Hill Book Comp.-Edn1981.

Operation research (OE-CS 501)

COURS OUTCOME:

After completion of the course students will be able to:

1. Express objective function and resource constraints in LP model in terms of decision variables and parameters.

2. Construct the initial transportation table for a trans-shipment problem and to solve a profit maximization transportation problem using suitable changes in the transportation algorithm.

3.Appreciate application of integer LP problem in several areas of managerial decision- making and to use linear programming approach to compute the value of the game when dominance rule do not apply.

4. Derive replacement policy for items whose running cost increases with time and to use various selective inventory control techniques to classify inventory items into broad categories.

5.Derive relationship among variety of performance measures using Probability Distributions and Dynamic Programming are used for Optimization.

DETAIL SYLLABUS

UNIT-1 Introduction To Linear Programming : Definition and scope of operations research (OR), OR model, Problem Formulation and Application of LPP model, Graphical LPP solution, Simplex method, Big M-method, Two phase method, Special cases in Simplex method application, Duality in Linear Programming, Dual Simplex method, Sensitivity analysis, various industrial application of Linear Programming

UNIT-2 Linear Programming Extension -Transportation Models: Formulation and Optimal solution of Transportation problem, Method of finding Initial Solution – **NWCM,, LCM, VAM**, Close loop in Transportation Table and its properties, Variation in Transportation problem – Degeneracy and its resolution, Trans Shipment models, Assignment models - Hungarian method for solving Assignment Problem, Travelling Salesman problem.

UNIT-3 Integer Programming ,Game Theory ,Sequencing and Project Management:

Integer Programming -Formulation and solution of Integer linear programming problems, Enumeration and cutting plane solution concept, Branch and Bound algorithm. **Game Theory** : Introduction, Two person Zero Sum Game, Minimax and, Maximin Principles Rules of Dominance. **Sequencing problems**-Travelling Salesman problem, Machine-scheduling problem (Job shop). **Project Management**-Objectives of **CPM** and **PERT,** Characteristic of **CPM/PERT** projects..

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UNIT-4 Replacement and Inventory models:

Replacement Problems- Optimal age of equipment replacement, Replacement of items that fail, Individual and group replacement policies.

Inventory models- Deterministic Inventory models, Classic **EOQ** model, **EOQ** with price breaks, single item Inventory control models without/with shortage, multi-item Inventory control models with constraints, single item Inventory control models with quantity discounts.

UNIT-5 Queuing Theory and Dynamic Programming:

Queuing Theory – Structure of a Queuing system, Probability Distribution in Queuing System, classification of Queuing models - Single server Queuing models/Multi server Queuing models.
Dynamic Programming- Dynamic Programming formulations, Bellman's principle of optimality, computation in Dynamic Programming, Forward and Backward recursions.

References:

Text / Reference Books:

1. Wayne L. Winston, "Operations Research" Thomson Learning,2003.
2. Hamdy H. Taha, "Operations Research-An Introduction" Pearson Education,2003.
3. R. Panneer Seevam, "Operations Research" PHI Learning, 2008.
4. V. K .Khanna, "Total Quality Management" New Age International, 2008.
5. Rao S.S. " Optimization Theory and Applications ", Willey Eastern Limited.
6. Taha H.A., " Operation Research-An Introduction ", Macmillan.
7. J .K. Sharma," Applied Operations Research", Trinity

Graph Theory (OE-CS 502)

Course outcomes:

After the course the student will have a strong background of the graph theory which has diverse applications in the area of computer science, biology, chemistry, physics & engineering.

DETAIL SYLLABUS

UNIT 1. Graphs: Graphs, Sub graphs, some basic properties, various example of graphs & their sub graphs, walks, trails, path & circuits, connected graphs, disconnected graphs and its components, various operation on graphs, unicursal line, Euler graphs, Hamiltonian paths and circuits, Hamiltonian graph, traveling salesman problem, Chinese Postman problem. Fleury's algorithm for constructing an Euler line in a graph G, directed graphs, types of directed graphs, directed paths and connectedness, circuits in digraph, Hamiltonian and Euler digraphs.

UNIT 2. Trees: Trees and its characterization, distance, eccentricity and centre, diameters, radius of a tree and pendent vertices, rooted and binary trees, spanning trees, height of a binary tree, traversing binary tree, depth-first search and breath first search in a graph. Branches and chord, rank and nulity, on counting trees, trees with directed edges, fundamental circuits, finding all spanning trees of a graph and a weighted spanning tree, minimum weight spanning tree algorithm, , Prim's, Kruskal's and Dijkstra's algorithm.

UNIT 3. Cut sets & Network flow, Planar Graphs: Cuts sets and cut vertices, some properties, all cut sets in a graph, fundamental circuits and cut sets, connectivity in a graph and separable graph.

Transportation Networks: Networks flows, Max-flow-min cut theorem.
Planar Graphs: planar graphs, region and its degree, Euler's formula, Kuratowski's theorem and its application to planarity detection of graphs,dual graphs, combinational and geometrical dual, thickness and crossings.
UNIT 4. Matrix Representation and Colouring of Graphs: Incidence matrix of graph, sub matrices of A(G), circuit matrix, cut set matrix, fundamen tal circuit matrix and rank of matrix B, path matrix ,adjacency matrices, adjacency matrix of a digraph and their properties . **Colouring Of Graphs** : Colouring, , chromatic number, colour critical graph, chromatic partitioning, chromatic polynomials, matching, maximal matching, augmenting path, covering, minimal covering , Four colour problems, five colour theorem.
UNIT 5. Enumeration of graphs: Enumeration: types of enumeration, counting of labelled and unlabelled graphs and trees, cycle index of permutation group, Cayley's theorem, statement of Burnside's theorem, figure counting series and configuration series, Polya's Enumeration(or counting)theorem, Application of Polya's theorem in Graph Enumeration.

REFERENCE

1. Deo N., Graph Theory with Applications to Engineering and Computer Science, Prentice-Hall, Inc.
2. Bondy and Murthy: Graph theory and application. Addison Wesley.
3. John M. Aldous and Robin J. Wilson: Graphs and Applications-An Introductory Approach, Springer
4. Robin J, Wilson: Introduction to Graph Theory, Addison Wesley
5.Kalika Patraj: Graph theory, S.K. Kataria & Son's, N .Delhi.

Computer based numerical and statistical techniques (OE-CS 503)

Course Outcomes:

1. Gain insight about design and analysis of standard searching and sorting algorithms. Learn various algorithm Analysis techniques.
2. Able to compare between different data structures i.e., trees, heaps etc. also, pick an appropriate data structure for a design situation.
3. Learn divide and conquer, Greedy paradigms and understand and analyze when an algorithmic design situation calls for them.
4. Developing and analyzing the solutions for the problems using Dynamic programming, backtracking and Branch and bound approaches..
5. Understand NP completeness and difference between NP-Hard & NP-complete problems..

Detailed Contents:

Unit 1:

Introduction: Numbers and their accuracy,Mathematical preliminaries, Errors and their Computation, General error formula, Error in a series approximation.

Solution of Algebraic and Transcendental Equation:

Bisection method, Iteration method, Aitken's Δ^2 method, method of False position, Newton-Raphson method, methods of finding complex roots, Rate of convergence of Iterative methods.

Unit 2:

Sorting and Order Statistics: Heapsort, Priority queues, Quicksort, Merge sort, Sorting in linear time.

Advanced Design and Analysis Techniques: Dynamic programming – Elements, Matrix-chain multiplication, longest common subsequence, Travelling Salesperson problem, Greedy algorithms – Elements, activity-selection problem, Huffman codes, task scheduling problem, Knapsack Problem, Backtracking – Elements, 8 – Queens, Graph Coloring, Hamiltonian Cycles.

Unit 3:

Advanced Data Structures: Operations in B-Trees, Binomial heaps, Fibonacci heaps, data structures for disjoint sets, strings.

Unit 4:

Graph Algorithms: Review of graph algorithms, topological sort, strongly connected components, minimum spanning trees – Kruskal and Prim's, Single source shortest paths, relaxation, Dijkstra's algorithm, Bellman-Ford algorithm, single source shortest paths for directed acyclic graphs.

Unit 5:

P – Hard & NP – Complete problems: Basic concepts, Clique Decision problem, Node Cover decision problem, Travelling Salesperson decision problem, Introduction to approximation algorithms Planer Graph Coloring, Maximum programs stored problem.

Suggested reference books:

1. Cormen, Leiserson and Rivest: Introduction to Algorithms, 2/e, PHI.
2. Horowitz, Sahni, and Rajasekaran: Fundamentals of Computer Algorithms, Second Edition, Universities Press, Hyderabad.
3. Aho, Hopcroft, and Ullman: The Design and Analysis of Computer Algorithms, Addison Wesley.

OE-EE 501	VLSI Circuits	L-T-P-C: 3-0-0-3
Course Outcomes: At the end of this course students will demonstrate the ability to		
CO1	Comprehend IC Fabrication Techniques	
CO2	Analyse and design MOSFET logic circuits	
CO3	Analyse and design CMOS logic circuits	
CO4	Design Read Only Memory, Random Access Memory	
CO5	Design Adders, multipliers	

UNIT-I

Material Preparation- Purification, Crystal growth (CZ and FZ process), wafer preparation Thermal Oxidation- Growth mechanisms, Dry and Wet oxidation, Deal Grove model.

Diffusion- Fick's Laws, Diffusion with constant surface concentration and from a constant source, diffusion techniques.

Ion implantation-Technique, Range Theory, annealing

UNIT-II

Epitaxy: Vapour phase epitaxy and molecular beam epitaxy

Lithography- Photo lithographic sequence, Electron Beam Lithography, Etching and metal deposition

Methods of isolation, Circuit component fabrication: transistor, diodes, resistors, capacitors, N-well CMOS IC Fabrication Sequence

UNIT-III

CMOS inverters- DC characteristics, switching characteristics, power dissipation

Layout Design rules, Stick Diagram and layout of CMOS Inverter, two input NAND and NOR gates

MOSFET Logic Design -Pass transistor logic, Complementary pass transistor logic and transmission gate logic, realization of functions

UNIT-IV

Read Only Memory- 4x4 MOS ROM Cell Arrays (OR,NOR,NAND)

Random Access Memory – SRAM-Six transistor CMOS SRAM cell, DRAM –Three transistor and One transistor Dynamic Memory Cell

Sense amplifiers – Differential Voltage Sensing Amplifiers Introduction to PLDs and FPGAs, Design of PLAs

UNIT-V

Adders - Static adder, Carry-By pass adder, Linear Carry- Select adder, Square- root carry- select adder

Multipliers - Array multipliers

Text Books:

1. John P Uyemura, Introduction to VLSI Circuits and Systems, Wiley India, 2006

2. S.M. SZE, VLSI Technology, 2/e, Indian Edition, McGraw-Hill,2003

References:

1. Jan M.Rabaey, Digital Integrated Circuits- A Design Perspective, Prentice Hall, Second Edition, 2005.

2. Neil H.E. Weste, Kamran Eshraghian, Principles of CMOS VLSI Design- A Systems Perspective, Second Edition. Pearson Publication, 2005

3. Razavi - Design of Analog CMOS Integrated Circuits,1e, McGraw Hill Education India Education, New Delhi, 2003.

4. Sung –Mo Kang & Yusuf Leblebici, CMOS Digital Integrated Circuits- Analysis & Design, McGraw-Hill, Third Ed., 2003.

5. Yuan Taur&Ning, Fundamentals of Modern VLSI Devices, Cambridge University Press, 2008

OPEN ELECTIVE –II

OEC	WATER RESOURCES CONSERVATION	OE-CE 601	3 0 0	3 CREDITS
COURSE OUTCOMES:				
CO1	Explain water hydrology and environmental influence.			
CO2	Outline the concepts of Artificial Ground Water Recharge.			
CO3	Learn the Concept of Water Harvesting.			
CO4	Explain Reuse & Recycle of Waste Water and Watershed Management.			

UNIT-I

Ground and Surface Water Utilization- Historical background, Hydrologic Cycle, Water Budget, Ground Water level fluctuations and Environmental influence.

UNIT-II

Artificial Ground Water Recharge: Concept & methods of artificial ground water recharge, recharge mounds & induced recharge, wastewater recharge for reuse, Water Spreading, Farm Ponds and Percolation Tanks.

UNIT-III

Water Harvesting: Rainwater harvesting, Catchment Harvesting, Harvesting Structures, Soil Moisture Conservation, Check Dams.

UNIT-IV

Reuse & Recycle of Waste Water: Types of reuse, Application of treated waste water, Purity of reclaimed water, Guidelines and Regulations, New technologies used in recycling of Waste Water.

UNIT-V

Watershed management- Introduction, Concept of watershed Management, Watershed Management policies and decision making.

REFERENCES

1. Ramakrishnan S.(1996),"Ground water", Scitech Publications, 2nd Edition.
2. Todd D.K. & Mays L. F.(2006),"Groundwater Hydrology", John Wiley and sons, 2nd Edition.
3. Murthy J.V.S.(1998), “Watershed Management”, New Age International Publishers, 2nd Edition.
4. Murthy V.V.N.(2013), “ Land and Water Management”, Kalyani Publications, 6th Edition.
5. US Environment Protection Agency, 1992. “Guidelines for Water Reuse”.

0EC	ENVIRONMENTAL MANAGEMENT	OE-CE 602	3 0 0	3 CREDITS
COURSE OUTCOMES:				
CO1	Identify the various environmental issues.			
CO2	Apply Environmental impact assessment.			
CO3	Apply the Environmental policies & technology for environment management.			
CO4	Identify the Contemporary issues.			
CO5	Apply the Environmental legislation.			

Unit I

Introduction: Need for environmental awareness, protection of natural and manmade systems, Impact of man on environment.
Emerging global environmental issues: Population growth, climate change and global warming effects, aid rain, ozone layer depletion, urbanization, automobile pollution

Unit II
EIA: Planning and management of environmental impact studies; Impact evaluation methodologies: base line studies, screening, scooping, checklist, overlays, Environmental impact assessment of water resources and environmental projects, Case study of power plant, Hydro power plant
EA: Meaning, audit items, audit procedure, safety audit.
Unit III
Sustainable development, Environmental economics, environmental policy in planned, mixed and market economies,
Emerging technologies for environmental management; Life cycle analysis- methodology, tools and problems, Concept of ISO and ISO 14000; Environmental cost benefit analysis, Decision methods for evaluation of alternatives, Environment risk assessment, Environmental valuation: Approaches to valuation.
Unit IV
Contemporary issues: Emission trading, discharge permits, international resource sharing issues, international environmental treaties and protocol.
Unit V
Environmental legislation: Introduction to various legislations related to water, air, biodiversity, ozone depletion etc at National and International level; Issues involved in the enforcement of environmental legislation, Initiatives by NGO‘s, Initiatives by Governments, CPCB, Other institutions of governance.

References :

- Principles of environmental studies (Ecology, economics, management and law) by C. Manoharachary and P. Jayarama Reddy, B.S. Publications.
- Environmental Impact Assessment Methodologies by Y. Ananayulu and C.A. Sastry, B.S.

OE-EC 601 Robotics

L-T-P-C
4-0-0-4

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

1- Understand the basics of robotic systems and different types of robots.
2- Perform kinematic and dynamic analyses with simulation.
3- Know about different types of sensors and robotic eye: geometry of image formation.
4- Know different types of actuators and grippers in robotics.
5- Select a robotic system for given industrial application.

Unit-1 (8 Hrs)

Introduction to Robotics: Types and components of a robot, Classification of robots,Different types of joints are used in robots, Kinematics systems, Definition of mechanisms and manipulators, Degrees of Freedom.

Unit-2

Robot Kinematics: Kinematic Modelling: Translation and Rotation Representation, Coordinate transformation, DH parameters, Forward and inverse kinematics, Jacobian, Singularity,

Dynamic Modelling: Forward and inverse dynamics, Equations of motion using Euler-Lagrange formulation, Newton Euler formulation.

Unit-3

Sensor: Contact and Proximity, Position, Velocity, Force, Tactile etc., Introduction to Cameras, Camera calibration, Geometry of Image formation, Vision applications in robotics.

Unit-4

Robot Actuation and gripper Systems: Types of Actuators: Electric, Hydraulic and Pneumatic. **Transmission:** Gears, Timing Belts and Bearings, Parameters for selection of actuators, grippers.

Unit-5

Robot Control: Basics of control: open loop- closed loop, Transfer functions, Control laws: P, PD, PID, Linear and Non-linear controls, Application of robotics systems: defence, medical, industries, etc., Robotics and Automation for Industry 4.0, Robot safety and social robotics.

Text/Reference Books:

1- Introduction to Robotics : J. Craig , Pearson
2- Robot Dynamics and Control, Spong & Vidyasagar, Mc Graw Hill
3- Robotics Engineering : R. Klafter, PHI - Robotics : Subir K Saha , Mc GrawHill
4- Industrial Robotics : M. P. Groover, Ashish Dutta , McGraw Hill

OE-EC 602 Mechatronics

L-T-P-C
4-0-0-4

Course Outcomes: After the successful completion of the course the students will be able to:

1. Identification of key elements of mechatronics system..
2. Understanding the concept of signal processing and use of interfacing systems such as ADC, DAC, digital I/O.
3. analyze the Interfacing of Sensors, Actuators using appropriate DAQ micro-controller
4. Understanding the concept of Time and Frequency domain analysis of system model (for control application)
5. Understanding the concept of PID control implementation on real time systems

Unit-1

Introduction: Introduction, scope and applications of Mechatronics systems. Process control automation, FMS and CNC Machines. MEMS: Basics of Micro- and Nanotechnology, microprocessor-based controllers and Microelectronics.

Unit-2

Introduction to Sensors: Linear and Rotational Sensors, Acceleration, Force, Torque, Power, Flow and Temperature Sensors, Light Detection, Image, and Vision Systems, Integrated Micro-sensors,

Introduction to Actuators: Electro-mechanical Actuators, Electrical Machines, Piezoelectric Actuators, Hydraulic and Pneumatic Actuation Systems, MEMS: Micro-transducers Analysis, Design and Fabrication.

Unit-3

Electronics elements in mechatronics, conductors, insulators and semiconductors, passive electrical components, resistors, capacitor and inductor, transformer, active elements, semiconductor devices, transistors and integrated circuits, digital electronics components like logic gates, flip-flops, shift register, multiplexer and counter. Computing elements in mechatronics, analog computer, timer, analog to digital converter, digital to analog converter,

Unit-4

System modeling and analysis, control system concepts, transfer function of physical systems, block diagrams representation of systems, transfer function of a system, standard input signals, time response of a first to a step input, frequency response analysis, automatic control systems,

Unit-5

Design of Mechatronics systems: Introduction of mechatronics systems: Home appliances, ABS (anti-lock braking system) and other areas in automotive engineering, Elevators and escalators

Data Acquisition and related Instrumentation: Introduction to Data Acquisition Measurement Techniques: Sensors and Transducers, Quantizing theory, Analog to Digital Conversion, Digital to

Analog (D/A) conversation, Signal Conditioning. Real time Instrumentation: Computer-Based Instrumentation Systems, Data Recording and Logging.

Text/Reference books:

1. Bolton, W., "Mechatronics: Electronic Control Systems in Mechanical and 2011 Electrical Engineering
2. Ramachandran K. P., Vijayaraghavan G. K., Balasundaram M.S. "Mechatronics: Integrated Mechanical Electronic Systems", Wiley
3. A Kuttan, "Introduction to Mechatronics, Oxford University Press, 2010.
4. Mechatronics HMT Hand Book, Tata McGraw Hill.
5. Alciatore and Histand, "Introduction to Mechatronics an Measurement Systems", Tata McGraw Hill.
6. Smaili and Mrad, "Mechatronics: Integrated Technologies for Intelligent Machines" Oxford
7. Mahalik N.P., "Mechatronics: Principles, Concepts and applications", Tata McGraw Hill.

Composite Materials (OE-ME 601)

L T P C

3 0 0 3

Prerequisite: Basic Knowledge of Materials Science.

Course Outcomes (COs):

1. Knowledge of the different types of engineering materials.
2. Knowledge of the types of reinforcements and fibers.
3. Understand the various types of composites used in engineering and their properties.
4. Describe the processing of composite materials and manufacturing techniques.
5. Understand and analyze the various methods of testing the composites.

Course Contents:

UNIT I

Introduction: Classifications of Engineering Materials, Concept of composite materials, Matrix materials, Functions ofa Matrix, Desired Properties of a Matrix, Polymer Matrix (Thermoset sand Thermoplastics), Metalmatrix, Ceramic matrix, Carbon Matrix, Glass Matrix etc.

UNIT II

Types of Reinforcements/Fibers: Role and Selection of reinforcement materials, Types of fibers, Glass fibers, Carbon fibers, Aramid fibers, Metal fibers, Alumina fibers, Boron Fibers, Silicon carbide fibers, Quartz and Silica fibers, Multiphase fibers, Whiskers, Flakes etc. Mechanical properties of fibres. Material properties that can be Improved by forming a composite material and its engineering potential.

UNIT III

Various types of composites: Classification based on Matrix Material: Organic Matrix composites, Polymer matrix composites (PMC),Carbon matrix Composites or Carbon-Carbon Composites, Metal matrix composites (MMC), Ceramicmatrix composites (CMC);Classification based on reinforcements: Fiber Reinforced Composites, FiberReinforced Polymer(FRP) Composites, Laminar Composites, Particulate Composites.

UNIT IV

Fabrication methods: Processing of Composite Materials: Overall considerations, Auto clavecuring, Other ManufacturingProcesses like filament welding, compression moulding, resin transplant method, pultrusion, pre-peglayer, Fiber-only performs, Combined Fiber-Matrix performs, Manufacturing Techniques: Tooling andSpecialty materials, Release agents, Peelplies, release films and fabrics, Bleeder

and breather plies, bagging films, maximum stress and strain criteria, Von Mises Yield criterion for isotropic materials.

UNIT V

Testing of Composites and Analysis: Mechanical testing of composites, tensile testing, Compressive testing, Intra-laminar shear testing, Inter-laminar shear testing, Fracture testing etc.Analysis of laminated plates- equilibrium equations of motion, energy formulation, static bending analysis, buckling analysis, free vibrations, natural frequencies.

Text Books:

1. Mechanical Metallurgy, by G. Dieter, McGraw Hill.
2. Engineering Materials: Polymers, Ceramics and Composites, by A.K Bhargava Prentice Hall India.
3. Analysis and Performance of Fiber Composites, by Agarwal, McGraw Hill.

Reference Books:

1. Materials characterization, Vol. 10, ASM hand book.
2. Thermal Analysis of Materials, by R.F. Speyer, Marcel Decker.
3. Engineering Mechanics and Composite Materials, by Daniels, Oxford University Press.
4. Material Science and Engineering (SIE) with CD, by Smith, McGraw Hill.
5. Gibson R.F. Principles of Composite Material Mechanics, second edition, McGraw Hill, 1994.

Entrepreneurship (OE-ME 602)

L T P C
3 0 0 3

Prerequisite: Basic Knowledge of industrial management.

Course Outcomes (COs):

1. Understand entrepreneurship and its related theory and government policies
2. Understand various Business Enterprises and Ownership Structure
3. Prepare project report and able to understand project evaluation method.
4. Understand various strategies and policies in management and enterprises.
5. Understand Institutional support towards the development of entrepreneurship.

Course Contents:

Unit I

Entrepreneurship: Definition, requirements to be an entrepreneur, entrepreneur and intrapreneur, entrepreneur and manager, growth of entrepreneurship in India, women entrepreneurship, rural and urban entrepreneurship.

Entrepreneurial Motivation: motivating factors, motivation theories-Maslow's Need Hierarchy Theory, McClelland's Acquired Need Theory, government's policy actions towards entrepreneurial motivation, entrepreneurship development programme.

Unit II

Business Enterprises and Ownership Structure Small scale, medium scale and large scale enterprises, role of small enterprises in economic development; proprietorship, partnership, companies and co-operatives firms: their formation, capital structure and source of finance.

Unit III

Project Management: Identification and selection of projects; project report: contents and formulation, concept of project evaluation, methods of project evaluation: internal rate of return method and net present value method.

Unit IV

Management of Enterprises: Strategy & policy, introduction to human resource management, marketing strategies, financial management & strategies: raising and managing capital, shares, debentures and bonds, cost of capital; break- even analysis.

Unit V

Institutional Support and Policies: Institutional support towards the development of entrepreneurship in India: Institutional framework, venture capitalist; technical consultancy organizations (TCOs), government policies for small scale enterprises.

Text Books:

1. Khanka, S S. 'Entrepreneurial Development', S Chand & Company Ltd. New Delhi.
2. Desai, Vasant, 'Project Management and Entrepreneurship', Himalayan Publishing House, Mumbai, 2002.
3. Gupta and Srinivasan, 'Entrepreneurial Development', S Chand & Sons, New Delhi.

Reference Books:

1. Ram Chandran, 'Entrepreneurial Development', Tata McGraw Hill, New Delhi
2. Saini, J. S. 'Entrepreneurial Development Programmes and Practices', Deep & Deep Publications (P), Ltd.
3. Holt, Davis, 'Entrepreneurship: New Venture Creations, PHI.

Mechanical System Design (OE-ME 603)

L T P C

3 0 0 3

Prerequisite: Basic Knowledge of Industrial Engineering.

Course Outcomes (COs):

After completing this course a student will be able to:

1. Understand the attributes characterizing a system and case study.
2. Explain the system modelling and case study compound bar system.
3. Differentiate and understand the graph modelling, graph analysis and materials handling systems.
4. Understand the method for optimization model with single system.
5. Justify the inventory control in production plant.

Course Contents:

UNIT I

Engineering process and System Approach Basic concepts of systems, Attributes characterizing a system, types of system, Application of system concepts, Advantages of system approach, Problems concerning systems, Concurrent engineering, A case study-Viscous lubrication system in wire drawing.

Problem Formulation: Nature of engineering problems, Need statement, hierarchical nature of systems, hierarchical nature of problem environment, problem scope and constraint, A case study: heating duct insulation system, high speed belt drive system.

UNIT II

System Theories: Introduction, System Analysis, Black box approach, state theory approach, component integration approach, Decision process approach, A case study- automobile instrumentation panel system. System modeling Introduction, Model types and purpose, linear systems, mathematical modeling, concepts, A case study compound bar system.

UNIT III

Graph Modeling and Analysis Graph Modeling and analysis process, path problem, Network flow problem, A case study: Material handling system.

Optimization Concepts Optimization processes, Selection of goals and objectives-criteria, methods of optimization, analytical, combinational, subjective. A case study: aluminum extrusion system.

UNIT IV

System Evaluation Feasibility assessment, planning horizon, time value of money, Financial analysis, A case study: Manufacture of maize starch system. 4 Calculus Method for Optimization Model with single decision variable, model with two decision variables, model with equality constraints, model with inequality constraints, A case study: Optimization of an insulation system.

UNIT V

Decision Analysis Elements of a decision problem, decision making, under certainty, uncertainty risk and conflict probability, density function, Expected monetary value, Utility value, Baye's theorem, A case study: Installation of machinery. 4 System Simulation Simulation concepts, simulation models, computer application in simulation, spread sheet simulation, Simulation process, problem definition, input model construction and solution, limitation of simulation approach, A case study: Inventory control in production plant.

Text Books:

1. Engineering Design, by Dieter, McGraw Hill.
2. Optimization Techniques-SS Rao.
3. Design Engineering-JR Dixon, TMH, New Delhi.
4. Engineering Design-Robert Matousck, Blackie and son ltd. Glasgow.

Reference Books:

1. An Introduction to Engineering Design Method-V Gupta and PN Murthy, TMH, New Delhi.
2. Design and Planning of Engineering systems-DD Reredith, KV Wong, RW Woodhead, and RR Worthman, Prentice Hall Inc., Eaglewood Cliffs, New Jerse.
3. System Analysis and Project Management-Devid I Cleland, William R King, McGraw Hill.

Product Design and Development (OE-ME 604)

L T P C

3 0 0 3

Prerequisite:

Course Outcomes (COs):

After completing this course a student will be able to:

1. Understand how to create new product based on mechanical design engineering.
2. Understand all mechanical aspects of product design by incorporating concept, creativity, structural, manufacturing, esthetic etc.
3. Solve open-ended problem belongs to design engineering that meet the requirements.
4. Understand various product designing methods.
5. Understand human factors and cost evaluation in industrial design concepts.

Course Contents:

Unit I

Design Fundamentals:

The importance of engineering design – types of design –the design process – relevance of product lifecycle issues in design –designing to codes and standards- societal considerations in engineering design –generic product development process – various phases of product development-planning for products – establishing markets- market segments- relevance of market research.

Unit II

Customer oriented design & Societal Considerations: Identification of customer needs- customer requirements- Quality Function Deployment Product Design Specifications- Human Factors in Design – Ergonomics and Aesthetics. Societal consideration - Contracts – Product liability – Protecting intellectual property – Legal and ethical domains – Codes of ethics - Ethical conflicts – Environment responsible design-future trends in interaction of engineering with society.

Unit III

Material selection processing and Design: Material Selection Process – Economics – Cost Vs Performance – Weighted property Index – Value Analysis – Role of Processing in Design – Classification of Manufacturing Process – Design for Manufacture – Design for Assembly –Designing for castings, Forging, Metal Forming, Machining and Welding – Residual Stresses – Fatigue, Fracture and Failure.

Unit IV

Design Methods: creativity and problem solving- creative thinking methods- generating design concepts - systematic methods for designing –functional decomposition – physical decomposition – functional representation – morphological methods-TRIZ- axiomatic design. Decision making theory- utility theory –decision trees –concept evaluation methods.

Unit V

Industrial Design concepts: Human factors design –user friendly design – design for serviceability – design for environment – prototyping and testing – cost evaluation –categories of cost –overhead costs – activity based costing – methods of developing cost estimates – manufacturing cost –value analysis in costing.

Text books:

1. Product Design & Manufacturing by A. K. Chitab& R. C. Gupta, PHI (EEE).
2. Product Design and Development by Karl T Ulrich, Steven D. Eppinger.
3. Product Design, by Kevin Otto, Kristin wood, Pearson Education Inc.

Reference books:

1. The Technology of Creation Thinking by R.P. Crew ford, Prentice Hall.
2. The Art of Thought by Grohem Walls, Bruce & Co., New York.
3. Product Design & Decision Theory by M.K. Starr, Prentice Hall.
4. Human Factor Engg. byMccormick E.J., McGrawHill.
5. Engineering: An Introduction to Creative profession by G.C. Beakley, H.W. Leach, Macmillan.
6. Industrial Design In Engineering – A marriage of Techniques by Charles H.Flurscheim, The Design Council - London.
7. Quality Control & Reliability Analysis by Bijendra Singh, Khanna Publications.

MODELING AND SIMULATION (OE-CS 601)

Course Outcomes:

Upon completion of the subject, students will be able to:

CO1: Understand the basics of simulation modeling and replicating the practical situations in organizations.

CO2: Realize Concepts in Discrete-Event Simulation and analyze and develop a number of simulation softwares.

CO3: understand and simulate various statistical and mathematical models

CO4: Generate random numbers and random variates using different techniques.

CO5: Analyze simulation data using input modelling as well as Understand Verification and Validation of simulation model.

Detail content

Unit 1: Introduction- advantages and disadvantages of simulation, application areas in communication, computer and software design, systems and systems environment, components of a system, discrete and continuous systems, model of a system, types of models, discrete-event simulation, steps in a simulation study. Simulation Examples- Simulation of queueing systems, on-demand and inventory systems, simulation for reliability analysis etc.

Unit 2: General Principles: Concepts in Discrete-Event Simulation, List Processing: properties and operations, data structures and dynamic allocation, techniques. **Simulation Software:** Selection of Simulation Software, review of some existing softwares like: Arena, AutoMod, Extend, Flexsim, Micro Saint, ProModel, Quest, SIMUL8, WITNESS etc., Experimentation and Statistical-Analysis Tools.

Unit 3: Statistical Models in Simulation: Useful Statistical Models, Discrete Distribution s, Continuous Distributions, Poisson Process, Empirical Distributions. **Queuing Models:** Characteristics of Queuing systems, Queuing Notation, Long Run Measures of performance of Queuing Systems, Steady State Behavior of infinite Population Markovian Models, Steady State Behavior of finite Population Models, Networks of Queues.

Unit 4: Random Number Generation: Properties of Random Numbers, Generation of Pseudo-Random Numbers, Techniques for Generating Random Numbers, Tests for Random Numbers, Inverse transform Techniques, Convolution Methods, and Acceptance –Rejection Techniques.

Unit 5:Input Modeling: Data collection, Identifying the Distribution with Data: Histograms, Selection of the Appropriate Family of Distributions, Quantile-Quantile Plots. Parameter Estimation: Sample Mean and Sample Variance and various biased and unbiased Estimators. Goodness of Fit Tests, Multivariate and Time-Series Input Models . **Verification and Validation of Simulation Models:** Model Building, Verification & Validation, Verification of simulation Models, Calibration & Validation of Models.

Suggested Readings/ Books:

1. Jerry Banks, John S. Carson II, Barry L. Nelson and David M. Nicol, Discrete-Event System and Simulation, Prentice Hall of India, New Delhi, 2005.

2. Deo Narsingh, "System Simulation with Digital Computers", PHI, New Delhi 1993.

3. Gordon G, "System Simulation", PHI 2nd Edition 1998.

4. Gabriel A. Wainer, Discrete-event modeling and simulation: a practitioner's approach, CRC Press, 2009.

5. K S Trivedi, "Probability and Statistics with Reliability, Queuing and Computer Science Application", PHI

6. Kleinrock, L.: Queuing Systems Vol.I, Vol.II, Wiley & Sons, London, 1975

INTERNET OF THING (OE-CS 602)

Course Outcomes:-

CO1:-To understand the fundamental concepts of IoT and apply them.

CO2:-To know the different hardware's used to embed them with IoT for the development of embedded applications.

CO3:-To learn the networking and communication aspects in IoT and analysis of different protocol used in IoT.

CO4:-Design and develop an application of IOT using ardunio platform.

CO5:-To comprehend the challenges faced for the development of an IoT application.

Unit I .

Internet of Things (IoT): Vision, Definition, Conceptual Framework, Architectural view, technology behind IoT, Sources of the IoT, M2M Communication, IoT Examples . Design Principles for Connected Devices: IoT/M2M systems layers and design standardization, communication technologies, data enrichment and consolidation, ease of designing and affordability.

Unit II

Hardware for IoT: Sensors, Digital sensors, actuators, radio frequency identification (RFID) technology, wireless sensor networks, participatory sensing technology. Embedded Platforms for IoT: Embedded computing basics, Overview of IOT supported Hardware platforms such as Arduino, NetArduino, Raspberry pi, Beagle Bone, Intel Galileo boards and ARM cortex.

Unit III

Network & Communication aspects in IoT: Wireless Medium access issues, MAC protocol survey, Survey routing protocols, Sensor deployment & Node discovery, Data aggregation & dissemination

Unit IV

Programming the Ardunio: Ardunio Platform Boards Anatomy, Ardunio IDE, coding, using emulator, using libraries, additions in ardunio, programming the ardunio for IoT.

Unit V

Challenges in IoT Design challenges: Development Challenges, Security Challenges, Other challenges IoT Applications : Smart Metering, E-health, City Automation, Automotive Applications, home automation, smart cards, Communicating data with H/W units, mobiles, tablets, Designing of smart street lights in smart city.

References:

1.Olivier Hersent,DavidBoswarthick, Omar Elloumi"The Internet of Things key applications and protocols", willey

2. Jeeva Jose, Internet of Things, Khanna Publishing House

3. Michael Miller "The Internet of Things" by Pearson

4. Raj Kamal "INTERNET OF THINGS", McGraw-Hill, 1ST Edition, 2016

5. ArshdeepBahga, Vijay Madisetti" Internet of Things(A hands on approach)" 1ST edition, VPI publications,2014

6. Adrian McEwen,HakinCassimally "Designing the Internet of Things" Wiley India

OE-EE-601	Electrical and Hybrid Vehicles	L-T-P-C: 3-0-0-3
Course Outcomes: At the end of this course students will demonstrate the ability to		
CO1	Understand the models used to describe hybrid vehicles and their performance.	
CO2	To comprehend electric and hybrid drive train topologies	
CO3	To realize different possible ways of energy storage	
CO4	Understand the different strategies of energy management	

UNIT I Introduction

Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, mathematical models to describe vehicle performance.

Introduction to Hybrid Electric Vehicles: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies.

Hybrid Electric Drive-trains: Basic concept of hybrid traction, introduction to various hybrid drive train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.

UNIT II Electric Trains

Electric Drive-trains: Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis. Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency

UNIT III Energy Storage

Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices. Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications, supporting subsystems

UNIT IV Energy Management Strategies

Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies. Case Studies: Design of a Hybrid Electric Vehicle (HEV), Design of a Battery Electric Vehicle (BEV).

Text / References:

1. A. K. Sawhney, “A Course in Electrical Machine Design”, DhanpatRai and Sons, 1970.

2. M.G. Say, “Theory & Performance & Design of A.C. Machines”, ELBS London.

3. S. K. Sen, “Principles of Electrical Machine Design with computer programmes”, Oxford and IBH Publishing, 2006.

4. K. L. Narang, “A Text Book of Electrical Engineering Drawings”, SatyaPrakashan, 1969.

5. A. Shanmugasundaram, G. Gangadharan and R. Palani, “Electrical Machine Design Data Book”, New Age International, 1979.

6. K. M. V. Murthy, “Computer Aided Design of Electrical Machines”, B.S. Publications, 2008.

7. Electrical machines and equipment design exercise examples using Ansoft’s Maxwell 2D machine design package.

OE-EE-602	Nano-electronics	L-T-P-C: 3-0-0-3
Course Outcomes: At the end of this course students will demonstrate the ability to		
CO1	Understand various concepts of nano-technology	
CO2	Comprehend the processes involved in making nano components and material	
CO3	Leverage advantages of the nano-materials and appropriate use in solving practical problems	

UNIT I

Introduction to nanotechnology, meso structures, Basics of Quantum Mechanics: Schrodinger equation, Density of States.

UNIT II

Particle in a box Concepts, Degeneracy- Band Theory of Solids.KronigPenny Model. Brillouin Zones.

UNIT III

Shrink-down approaches: Introduction, CMOS Scaling, The nanoscale MOSFET, Finfets, Vertical MOSFETs, limits to scaling, system integration limits (interconnect issues etc.),

UNIT IV

Resonant Tunneling Diode, Coulomb dots, Quantum blockade, Single electron transistors,Carbon nanotube electronics, Bandstructure and transport, devices, applications, 2D semiconductors and electronic devices, Graphene, atomistic simulation

Text/ Reference Books:

1. G.W. Hanson, Fundamentals of Nanoelectronics, Pearson, 2009.

2. W. Ranier, Nanoelectronics and Information Technology (Advanced Electronic Materialand Novel Devices), Wiley-VCH, 2003.

3. K.E. Drexler, Nanosystems, Wiley, 1992.

4. J.H. Davies, The Physics of Low-Dimensional Semiconductors, Cambridge University Press, 1998.

5. C.P. Poole, F. J. Owens, Introduction to Nanotechnology, Wiley, 2003

OPEN ELECTIVE –III

OEC	Finite Element Analysis	OE-CE 701	3 0 0	3 CREDITS
COURSE OUTCOMES:				
CO1	Develop the ability to solve complex problems using finite no of elements by any standard FEM software or even by self developed programs.			
CO2	Implement numerical methods to solve mechanics of solids problems.			
CO3	Formulate and Solve axially loaded bar Problems.Formulate and analyze truss and beam problems.			
CO4	Implement the formulation techniques to solve two-dimensional problems using triangle and quadrilateral elements.			
CO5	Formulate and solve Axi-symmetric and heat transfer problems.			

UNIT - I

Introduction to Finite Element Analysis: Introduction Basic Concepts of Finite Element Analysis Introduction to Elasticity Steps in Finite Element Analysis
Finite Element Formulation Techniques: Virtual Work and Variational Principle, Galerkin Method, Finite Element Method: Displacement Approach, Stiffness Matrix and Boundary Conditions

UNIT - 2

Element Properties: Natural Coordinates, Triangular Elements, Rectangular Elements, Lagrange and Serendipity Elements, Solid Elements, Iso parametric Formulation, Stiffness Matrix of Iso parametric Elements, Numerical Integration: One Dimensional. Numerical Integration: Two and Three dimensional

UNIT - 3

Analysis of Frame Structures: Stiffness of Truss Members, Analysis of Truss, Stiffness of Beam Members, Finite Element Analysis of Continuous Beam, Plane Frame Analysis, Analysis of Grid and Space Frame

UNIT – 4

FEM for Two and Three Dimensional Solids: Constant Strain Triangle, Linear Strain Triangle, Rectangular Elements, Numerical Evaluation of Element Stiffness, Computation of Stresses, Geometric Nonlinearity and Static Condensation

UNIT - 5

Axi symmetric Element: Finite Element Formulation of Axi symmetric Element, Finite Element Formulation for 3 Dimensional Elements Introduction to Plates and Shells

Text Book:

- C.S.Desai & J.F.Abel Introduction to Finite Element Method, CBS Publishers & Distributors – Volume 58, Issue 1 (2001). Reference Books:
- O.C.Zienkiewicz Finite Element Method for Engineers and scientists McGraw-Hill (2013).
- K.J.Bathe & E.L.Wilson Numerical Methods in Finite Element Analysis – (2014).
- S.S. Rao Finite Element Method in Engineering Butterworth-Heinemann (2011)

OEC	Environmental Impact Analysis	OE-CE 702	3 0 0	3 CREDITS
COURSE OUTCOMES:				
CO1	Understand various EIA factors. Learn the basics relationship of Environment Impact Analysis			
CO2	Understand the EIA methodologies. Learn different aspects of Environmental Audit			
CO3	Understand the Different Environmental Management Plan			
CO4	Understand the concept of Ecological Foot Print and Carbon Trading			

Unit I

Environmental impact assessment (EIA), definitions and concepts, rationale and historical development of EIA, EIA in Civil Engineering,

Unit II

Initial environmental examination, environmental impact statement, environmental appraisal, environmental impact factors and areas of consideration, measurement of environmental impact, organization, scope and methodologies of EIA, status of EIA in India

Unit III

Environmental Management :- principles, problems and strategies; Review of political, ecological and remedial actions; future strategies; multidisciplinary environmental strategies, the human, planning, decision-making and management dimensions.

Unit IV

Environmental audit, definitions and concepts, partial audit, compliance audit, methodologies and regulations; introduction to ISO and ISO 14000; Life cycle assessment; Triple bottom line approach; Industrial Ecology; Ecological foot printing; Carbon trading; Sustainable development

Reference/ Text Books:

- Rau, G.J. and Wooten, C.D., Environmental Impact Analysis Handbook, New York: McGraw Hill; 1980.
- Canter R.L. "Environmental Impact Assessment" New Delhi: McGraw Hill Inc.; 1996.
- Shukla S.K. and Srivastava, P.R., "Concepts in Environmental Impact Analysis", New Delhi: Common Wealth Publishers; 1992.

OE-EC 701 Digital System Design using VHDL

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

Course Outcomes: After the successful completion of the course the students will be able to:

1. Develop a digital logic and apply it to solve real life problems.
2. Analyze, design and implement combinational logic circuits.
3. Classify different semiconductor memories.
4. Analyze, design and implement sequential logic circuits.
5. Simulate and implement combinational and sequential circuits using VHDL systems.

Unit-1

Principles of combinational logic: Review of Boolean Algebra. Definition of combinational, Canonical forms, Generation of switching equations from truth tables, Karnaugh maps-3, 4 and 5 variables. Incompletely specified functions (Don't care terms). Simplifying max – term equations. Quine - McClusky minimization technique, Quine – McClusky using don't care terms, Reduced Prime Implicant tables, Map entered variables

Unit-2

Analysis and design of Combinational Logic: General approach, Decoders-BCD decoders, Encoders. Digital multiplexers-using multiplexers as Boolean function generators. Adders and Subtractors-Cascading full adders, Look ahead carry adder, Binary comparators.

Unit-3

Sequential Circuits: Basic Bi-stable element, Latches, SR latch, Application of SR latch, A Switch debouncer. The SR latch, The gated SR latch. The gated D Latch, The Master-Slave Flip-Flops (Pulse-Triggered Flip-Flops): The master-slave SR Flip-Flops, The master-slave JK Flip-Flop, Edge Triggered Flip-flop: The Positive Edge-Triggered D Flip-Flop, Negative-Edge Triggered D Flip-Flop. Characteristic equations, Registers, Counters-Binary Ripple Counter, Synchronous Binary counters, Counters based on Shift Registers, Design of a Synchronous counters, Design of a Synchronous Mod-N counters using clocked JK Flip-Flops Design of a Synchronous Mod-N counter using clocked D, T, or SR Flip-Flops

Unit-4

Sequential Design: Introduction, Mealy and Moore models, State machine notation, synchronous sequential circuit analysis and design. Construction of state Diagrams, Counters Design.

Unit-5

HDL: Introduction, A brief history of HDL, Structure of HDL Module, Operators, Data types, Types of Descriptions, Simulation and synthesis, Brief comparison of VHDL and Verilog. Data-Flow Descriptions: Highlights of Data flow descriptions, Structure of data-flow description, Data type-vectors.

Text/Reference Books:

1. Digital Logic Applications and Design John M Yarbrough Cengage Learning 2011
2. Digital Principles and Design Donald D Givone McGraw Hill Education 1 st Edition, 2002
3. Logic and computer design Fundamentals M. Morries Mano and Charles Kime Pearson Learning 4 th Edition, 2014
4. Circuit Design and Simulation with VHDL Volnei A Pedroni PHI 2nd Edition,
5. Fundamentals of logic design Charles H Roth, JR and Larry L. Kinney Cengage Learning 6th Edition, 2013
6. Fundamentals of Digital Circuits A. Anand Kumar PHI 3rd Edition, 2014
7. Digital Logic Design and VHDL A.A.PhadkeS.M.Deokar Wiley India 1st Edition, 2009
8. Digital Circuits and Design D.P.KothariJ.S.Dhillon Pearson First Print 2015
9. HDL Programming (VHDL and Verilog) Nazeih M. BotrosCengage Learning 1st Edition, 2011

OE-EC 702 Micro-Electro Mechanical Systems

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

Course Outcomes: After the successful completion of the course the students will be able to:

1. Gain knowledge of basic approaches for micro/Nano system design.
2. Understanding the concept of state-of-the-art lithography techniques for micro/Nano systems.
3. Aanalyze the Interfacing of Sensors, Actuators using appropriate DAQ micro-controller.
4. Learn new materials, science and technology for micro/Nano system applications.
5. Understand state-of-the-art micromachining and packaging technologies.

Unit-1

Introduction: Overview of MEMS and Microsystems: MEMS and Microsystem, Typical MEMS and Microsystems Products, Evolution of Micro-fabrication, Microsystems and Microelectronics, Multidisciplinary Nature of Microsystems, Miniaturization. Applications and Markets

Unit-2

Working Principles of Microsystems: Introduction, Microsensors, Microactuation, MEMS with Microactuators, Microaccelerometers, Microfluidics.

Unit-3

Material Processing: Silicon Wafer processing, Lithography, Thin-Film Deposition, Etching (Wet and Dry), Wafer Bonding and Metallization, Thick film processing, Smart Material processing, Emerging trends

Unit-4

Electronic circuit and Control: Carrier concentration, semiconductor diodes, transistor, MOSFET, Introduction to operational amplifier, Examples from Micro system, Transfer Function, state space modeling model order reduction, examples from smart systems

Unit-5

Micro-manufacturing, Integration and Packaging: Introduction, Bulk Micro-manufacturing, Surface Micromachining, The LIGA Process ,Integration and Packaging of Micro-electromechanical systems.

Text/Reference Books:

1. MEMS, NitaigourPremchandMahalik, TMH Publishing co.
2. Foundation of MEMS, Chang Liu, Prentice Hall Ltd.
3. MEMS and NEMS, Sergey EdwrdLyshevski, CRC Press, Indian Edition.
4. MEMS and Micro Systems: Design and Manufacture, Tai-Ran Hsu, TMH Publishers.
5. Introductory MEMS, Thomas M Adams, Richard A Layton, Springer International Publishers.

Non-Conventional Energy Resources (OE-ME 701)

L T P C

3 0 0 3

Prerequisite: Basic Knowledge of Power Plant Engineering.

Couse Outcomes (COs):

1. Illustrate the generation of electricity from various Non-Conventional sources of energy, have a working knowledge on types of fuel cells.
2. Study the solar energy, Utilization of it, Principles involved in solar energy collection and conversion of it to electricity generation.
3. Study the working principle of geothermal energy,Magneto-hydrodynamics (MHD) and fuel cell technology for energy generation.
4. Explore the concepts involved in wind energy conversion system by studying its components, types and performance.
5. Study the working principle of bio mass, wave and tidal wave and OTEC.

Course Contents:

Unit I

Introduction: Various non-conventional energy resources- Introduction, availability, classification, relative merits and demerits.

Solar Cells: Theory of solar cells. solar cell materials, solar cell array, solar cell power plant, limitations.

UNIT II

Solar Thermal Energy: Solar radiation, flat plate collectors and their materials, applications and performance, focusing of collectors and their materials, applications and performance; solar thermal power plants, thermal energy storage for solar heating and cooling, limitations.

UNIT III

Geothermal Energy: Resources of geothermal energy, thermodynamics of geo-thermal energy conversion-electrical conversion, non-electrical conversion, environmental considerations.

Magneto-hydrodynamics (MHD): Principle of working of MHD Power plant, performance and limitations.

Fuel Cells: Principle of working of various types of fuel cells and their working, performance and limitations.

UNIT IV

Thermo-electrical and thermionic Conversions: Principle of working, performance and limitations.

Wind Energy: Wind power and its sources, site selection, criterion, momentum theory, classification of rotors, concentrations and augments, wind characteristics. performance and limitations of energy conversion systems.

UNIT V

Bio-mass: Availability of bio-mass and its conversion theory.

Ocean Thermal Energy Conversion (OTEC): Availability, theory and working principle, performance and limitations.

Wave and Tidal Wave: Principle of working, performance and limitations. Waste Recycling Plants.

Text Books:

1. Raja etal, "Introduction to Non-Conventional Energy Resources" Scitech Publications.
2. D.S. Chauhan,"Non-conventional Energy Resources" New Age International.
3. C.S. Solanki, "Renewal Energy Technologies: A Practical Guide for Beginners" PHI Learning.

Reference Books:

1. John Twideu and Tony Weir, "Renewal Energy Resources" BSP Publications, 2006.
2. M.V.R. Koteswara Rao, "Energy Resources: Conventional & Non-Conventional " BSP Publications,2006.

Nanotechnology (OE-ME 702)

L T P C

3 0 0 3

Prerequisite: Basic Knowledge of Materials Science.

Course Outcomes (COs):

After completion of this course student will be able to:

1. Explain the fundamental principles of nanotechnology and their application to engineering.
2. Apply engineering and physics concepts to the Nano-scale and non-continuum domain.
3. Study the properties of individual Nano particles, metal Nano clusters and semi conducting nanomaterial.
4. Discuss and evaluate state-of-the-art characterization methods for nanomaterial, and determine nanomaterial safety and handling methods required during characterization.
5. Explain methods of fabricating nanostructures of carbon Buckey Ball, Carbon nano-tubes

Course Contents:

Unit I

Introduction: Definition of Nano-Science and Nano Technology, Applications of Nano-Technology.

Introduction to Physics of Solid State:Structure: Size dependence of properties; crystal structures, face centered cubic nanoparticles; Tetrehedrally bounded semiconductor structures; lattice vibrations. **Energy Bands:** Insulators, semiconductor and conductors; Reciprocal space; Energy bands and gaps of semiconductors; effective masses; Fermi Surfaces.

Localized Particles: Acceptors and deep taps; mobility; Excitons.

Unit II

Quantum Theory For Nano Science: Time dependent and time independent Schrodinger wave equations. Particle in a box, Potential step: Reflection and tunneling (Quantum leak). Penetration of Barrier, Potential box(Trapped particle in 3D:Nanodot), Electron trapped in 2D plane(Nano sheet), Quantum confinement effect in nano-materials.

Quantum Wells, Wires and Dots: Preparation of Quantum Nanostructure; Size and Dimensionality effect, Fermigas; Potential wells; Partial confinement; Excitons; Single electron Tunneling, Infrared etectors; Quantum dot laser Superconductivity.

Properties of Individual Nano particles,Metal Nano clusters: Magic Numbers; Theoretical Modelling of Nanopraticles; geometric structure; electronic structure; Reactivity; Fluctuations Magnetic Clusters; Bulle to Nano structure.

Semi conducting Nanoparticles: Optical Properties; Photofragmentation; Coulmbic explosion.

Rare Gas & Molecular Clusters: Inert gas clusters; Superfluid clusters molecular clusters.

Unit III

Growth Techniques of Nanomaterials: Lithograpahic and Nonlithograpahic techniques, Sputtering and film deposition in glow discharge, DC sputtering technique (p-$CuAlO_2$ deposition). Thermal evaporation technique, E-beam evaporation, Chemical Vapour deposition(CVD), Synthesis of carbon nano-fibres and multi-walled carbon nanotubes, Pulsed Laser Deposition, Molecular beam Epitoxy, Sol-Gel Techniuqe (No chemistry required), Synthesis of nanowires/rods, Electrodeposition, Chemical bath deposition, Ion beam deposition system, Vapor-Liquid –Solid (VLS) method of nanowires. **8**

Unit IV

Methods of Measuring Properties:Structure: Crystallography, particle size determination, surface structure,

Microscopy: Scanning Prob Microscopy (SPM), Atomic Force Microscopy (AFM), Field Ion Microscopy, Scanning Electron Microscopy, Transmission Elecrtron Microscopy (TEM)

Spectroscopy: Infrared and Raman Spectroscopy, X-ray Spectroscopy, Magnetic resonance, Optical and Vibrational Spectroscopy, Luninscence.

Unit V

Buckey Ball: Nano structuresofcarbon(fullerene): **Carbon nano-tubes:** Fabrication , structure. electrical, mechanical, and vibrational properties and applications. Nano diamond, Boron Nitride Nano-tubes, single elecron transistors, Moelcular machine, Nano-Biometrics, Nano Robots.

Text Books:

1. A.K.Bandyopadhyay, “Nano Materials” New Age International.
2. “Introduction to S.S. Physics” - (7^{th} Edn.) Wiley 1996.

Reference Books:

1. C.P.PooleJr F.J. Owens, “Introduction to Nanotechnology”. (5).
2. S. Sugano & H. Koizuoni, “Microcluster Physics” –Springor 1998.
3. “Handboole of Nanostructured Materials & Nanotechnology” vol.-5. Academic Press 2000.

Non-Destructive Evaluation (OE-ME 703)

L T P C

3 0 0 3

Prerequisite: Basic Knowledge of Material Science and Engineering.

Course Outcomes (COs):

After completion of this course student will be able to:

1. Obtain the fundamental knowledge about different NDT methods and visual inspection.
2. Explain the principles and testing knowledge of DPT(liquid penetrate inspection) and MPT for product testing.
3. Explain the principles and techniques in Radiography Testing.
4. Describe the knowledge about Ultrasonic Testing for products.
5. Understand the materials and testing procedure for Eddy Current Inspection&Thermography Testing.

Course Contents:

Unit I

Introduction:Scope and advantages of NDT, Comparison of NDT with Destructive Testing, some commonNDT methods used since ages, Terminology, Flaws and Defects, Visual inspection, Equipmentused for visual inspection. Ringing test, chalk test (oil whitening test). Uses of visual inspectiontests in detecting surface defects and their interpretation, advantages &limitations of visual inspection.

Unit II

Tests: Die penetrate test (liquid penetrate inspection), Principle, scope. Equipment & techniques, Test stations, Advantages, types of penetrants and developers, Zyglo test, Illustrative examples andinterpretation of defects.Magnetic particle Inspection – scope and working principle, Ferro Magnetic and Nonferromagnetic materials, equipment & testing. Advantages, limitations Interpretation of results,DC& AC magnetization, Skin Effect, use of dye & wet powders for magna glow testing,different methods to generate magnetic fields, Applications.

Unit III

Radiographic methods: Introduction to electromagnetic waves and radioactivity, various decays, Attenuation ofelectromagnetic radiations, Photo electric effect, Rayleigh's scattering (coherent scattering),Compton's scattering (Incoherent scattering), Pair production, Beam geometry and

Scatteringfactor. X-ray radiography: principle, equipment & methodology, applications, types of radiations andlimitations. γ-ray radiography – principle, equipment., source of radioactive materials &technique, advantages of γ-ray radiography over X-ray radiography Precautions against radiationhazards. Case Study - casting and forging.

Unit IV

Ultrasonic testing methods: Introduction, Principle of operation, Piezoelectricity. Ultrasonic probes, CRO techniques,advantages, Limitation & typical applications. Applications in inspection of castings, forgings,Extruded steel parts, bars, pipes, rails and dimensions measurements. Case Study – Ultrasonography of human body.

Unit V

Special NDT Techniques: Eddy Current Inspection: Principle, Methods, Equipment for ECT, Techniques, Sensitivity,advanced ECT methods. Application, scope and limitations, types of Probes and Case Studies.Introduction to Holography, Thermography and Acoustic emission Testing.

Text Books:

1. Non-Destructive Testing and Evaluation of Materials, by- Prasad, McGraw Hill Education
2. Practical Non-destructive Testing, by- Baldev Raj, T. Jayakumar, M. Thavasimuthu, WoodheadPublishing.
3. Non-Destructive Testing Techniques, by- Ravi Prakash, New Age International.

Reference Books

1. Nondestructive Testing Handbook,by Robert C. McMaster, American Society for Nondestructive.
2. Introduction to Nondestructive Testing: A Training Guide, by- Paul E. Mix, wiley.
3. Electrical and Magnetic Methods of Non-destructive Testing, by- J. Blitz, springer.
4. Practical non destructive testing by Raj, Baldev.
5. Basics of Non-Destructive Testing, by Lari& Kumar, KATSON Books.

Introduction to Mechanical Micro Machining (OE-ME 704)

L T P C

3 0 0 3

Prerequisite: Basic Knowledge of Conventional machining processes..

Course Outcomes (COs):

1. Understand of process of Ultra Sonic Micro Machining, Abrasive Jet Micro Machining, Water Jet Micro Machining etc.
2. Explain the Beam Energy based micro machining, Electron Beam Micro Machining, Laser Beam Micro Machining, Electric Discharge Micro Machining etc.
3. To understand the Magneto Rheological abrasive flow finishing, Magnetic Float polishing, Elastic Emission Machining etc.
4. Understand of Micro bending with LASER, LASER micro welding, Electron beam for micro welding.
5. Understand the Metrology for micro machined components and Machining of Micro gear, micro nozzle, micro pins, Applications.

Course Contents:

UNIT I

MICRO MACHINING: Ultra Sonic Micro Machining, Abrasive Jet Micro Machining, Water Jet Micro Machining, Abrasive Water Jet Micro Machining, Micro turning, Chemical and Electro Chemical Micro Machining, Electric discharge micro machining.

UNIT II

MICRO MACHINING: Beam Energy based micro machining, Electron Beam Micro Machining, Laser Beam Micro Machining, Electric Discharge Micro Machining, Ion Beam Micro Machining, Plasma Beam Micro Machining, Hybrid Micro machining, Electro Discharge Grinding, Electro Chemical spark micro machining, Electrolytic in process Dressing.

UNIT III

NANO POLISHING: Abrasive Flow finishing, Magnetic Abrasive Finishing, Magneto rheological finishing, Magneto Rheological abrasive flow finishing, Magnetic Float polishing, Elastic Emission Machining, chemo-mechanical Polishing.

UNIT IV

MICRO FORMING AND WELDING: Micro extrusion, Micro and Nano structured surface development by Nano plastic forming and Roller Imprinting, Micro bending with LASER, LASER micro welding, Electron beam for micro welding.

UNIT V

RECENT TRENDS AND APPLICATIONS: Metrology for micro machined components, Ductile regime machining, AE based tool wear compensation, Machining of Micro gear, micro nozzle, micro pins, Applications.

Text Books:

1. Jain V. K., Micro Manufacturing Processes, CRC Press, Taylor & Francis Group, 2012.
2. Jain V.K., _Introduction to Micro machining‘ Narosa Publishing House, 2011
3. Jain V.K., Advanced Machining Processes, Allied Publishers, Delhi, 2002.

Reference Books:

1. Janocha H., Actuators – Basics and applications, Springer publishers – 2012
2. Bharat Bhushan, Handbook of nanotechnology, springer, Germany, 2010.
3. Bandyopadhyay. A.K., Nano Materials, New age international publishers, New Delhi, 2008, ISBN:8122422578.
4. Mcgeoug.J.A., Micromachining of Engineering Materials, CRC press 2001, ISBN-10:0824706447.

Data science (OE-CS 701)

Course Outcomes

CO1.Describe what Data Science is and the skill sets needed to be a data scientist. • Explain in basic terms what Statistical Inference means. Identify probability distributions commonly used as foundations for statistical modeling. Fit a model to data.

CO2. Use R to carry out basic statistical modeling and analysis.

CO3. Explain the significance of exploratory data analysis (EDA) in data science. Apply basic tools (plots, graphs, summary statistics) to carry out EDA.

CO4. Describe the Data Science Process and how its components interact

CO5 Use APIs and other tools to scrap the Web and collect data. And Apply EDA and the Data Science process in a case study.

Unit 1. Introduction: What is Data Science? - Big Data and Data Science hype – and getting past the hype - Why now? – Datafication - Current landscape of perspectives - Skill sets needed . Statistical Inference - Populations and samples - Statistical modeling, probability distributions, fitting a model - Intro to R

Unit 2. Exploratory Data Analysis and the Data Science Process - Basic tools (plots, graphs and summary statistics) of EDA - Philosophy of EDA - The Data Science Process - Case Study: RealDirect (online real estate firm) Three Basic Machine Learning Algorithms - Linear Regression - k-Nearest Neighbors (k-NN) - k-means

Unit 5. One More Machine Learning Algorithm and Usage in Applications - Motivating application: Filtering Spam - Why Linear Regression and k-NN are poor choices for Filtering Spam - Naive Bayes and why it works for Filtering Spam - Data Wrangling: APIs and other tools for scrapping the Web Feature Generation and Feature Selection (Extracting Meaning From Data) - Motivating application: user (customer) retention - Feature Generation (brainstorming, role of domain expertise, and place for imagination) - Feature Selection algorithms – Filters; Wrappers; Decision Trees; Random Forests

Unit 4 Recommendation Systems: Building a User-Facing Data Product - Algorithmic ingredients of a Recommendation Engine - Dimensionality Reduction - Singular Value Decomposition - Principal Component Analysis - Exercise: build your own recommendation system 8. Mining Social-Network Graphs - Social networks as graphs - Clustering of graphs - Direct discovery of communities in graphs - Partitioning of graphs - Neighborhood properties in graphs

Unit 5. Data Visualization - Basic principles, ideas and tools for data visualization 3 - Examples of inspiring (industry) projects - Exercise: create your own visualization of a complex dataset 10. Data Science and Ethical Issues - Discussions on privacy, security, ethics - A look back at Data Science - Next-generation data scientists

References

Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk From The Frontline. O'Reilly. 2014.

• Jure Leskovek, Anand Rajaraman and Jeffrey Ullman. Mining of Massive Datasets. v2.1, Cambridge University Press. 2014. (free online)

• Kevin P. Murphy. Machine Learning: A Probabilistic Perspective. ISBN 0262018020. 2013.

• Foster Provost and Tom Fawcett. Data Science for Business: What You Need to Know about Data Mining and Data-analytic Thinking. ISBN 1449361323. 2013.

• Trevor Hastie, Robert Tibshirani and Jerome Friedman. Elements of Statistical Learning, Second Edition. ISBN 0387952845. 2009. (free online)

• Avrim Blum, John Hopcroft and Ravindran Kannan. Foundations of Data Science

• Mohammed J. Zaki and Wagner Miera Jr. Data Mining and Analysis: Fundamental Concepts and Algorithms. Cambridge University Press. 2014.

• Jiawei Han, Micheline Kamber and Jian Pei. Data Mining: Concepts and Techniques, Third Edition. ISBN 0123814790. 2011.

BIG DATA ANALYTICS (OE-CS 702)

COURSE OUTCOMES:

CO1:- To know the fundamental concepts of big data and analytics.

CO2:- To understand the different way to classify the given data using different techniques.

CO3:- To explore tools and practices for working with big data

CO4:- To learn about stream computing.

CO5:- To know about the research that requires the integration of large amounts of data.

UNITI

INTRODUCTION TO BIGDATA

Evolution of Big data - Best Practices for Big data Analytics - Big data characteristics - Validating - The Promotion of the Value of Big Data - Big Data Use Cases- Characteristics of Big Data Applications - Perception and Quantification of Value -Understanding Big Data Storage - A General Overview of High- Performance Architecture - HDFS - MapReduce and YARN - Map Reduce Programming Model

UNIT III

ASSOCIATION AND RECOMMENDATIONSYSTEM

Advanced Analytical Theory and Methods: Association Rules - Overview - Apriori Algorithm - Evaluation ofCandidateRules - Applications of Association Rules - Finding Association& finding similarity.

Recommendation System: Collaborative Recommendation- Content Based Recommendation - Knowledge Based Recommendation- Hybrid RecommendationApproaches.

UNIT IV

STREAMMEMORY

Introduction to Streams Concepts – Stream Data Model and Architecture - Stream Computing, Sampling Data in a Stream – Filtering Streams – Counting Distinct Elements in a Stream – Estimating moments – Counting oneness in a Window – Decaying Window – Real time Analytics Platform(RTAP) applications - Case Studies - Real Time Sentiment Analysis, Stock Market

Predictions. Using Graph Analytics for Big Data: GraphAnalytics

UNIT V

NOSQL DATA MANAGEMENT FOR BIG DATAAND VISUALIZATION

NoSQL Databases : Schema-less Models‖: Increasing Flexibility for Data Manipulation-Key Value Stores- Document Stores - Tabular Stores - Object Data Stores - Graph Databases Hive - Sharding –- Hbase – Analyzing big data with twitter - Big data for E-Commerce Big data for blogs - Review of Basic Data Analytic Methods using R.

TEXT BOOKS:

1. AnandRajaraman and Jeffrey David Ullman, "Mining of Massive Datasets", Cambridge University Press, 2012.

2. David Loshin, "Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph", Morgan Kaufmann/El sevier Publishers, 2013.

OE-CS 703	**Artificial Intelligence**	**3L-0T-0P**	**CREDIT -3**

Course outcome expected:

By end of this course the student should be able to

CO1: To Demonstrate knowledge of the building blocks of AI as presented in terms of intelligent agents. Apply concept of Natural Language processing to problems leading to understanding of cognitive computing.

CO2: To Analyze and formalize the problem as a state space, graph, design heuristics and select amongst different search or game based techniques to solve them.

CO3: Develop intelligent algorithms for constraint satisfaction problems and also design intelligent systems for Game Playing.

CO4: To study and apply the basic issues of knowledge representation and Logic and blind and heuristic search, as well as an understanding of other topics such as chaining, resolution, etc. that play an important role in AI programs.

CO5: To understand various machine learning techniques and models.

SYLLABUS

UNIT I Introduction: Introduction to Artificial Intelligence, Foundations and History of Artificial Intelligence, Applications of Artificial Intelligence, Intelligent Agents, Structure of Intelligent Agents. Computer vision, Natural Language Possessing.

Unit II Introduction to Search : Searching for solutions, Uniformed search strategies, Informed search strategies, Local search algorithms and optimistic problems, Adversarial Search, Search for games, Alpha - Beta pruning

Unit III Knowledge Representation & Reasoning: Propositional logic, Theory of first order logic, Inference in First order logic, Forward & Backward chaining, Resolution, Probabilistic reasoning, Utility theory, Hidden Markov Models (HMM), Bayesian Networks.

Unit IV Machine Learning : Supervised and unsupervised learning, Decision trees, Statistical learning models, Learning with complete data - Naive Bayes models, Learning with hidden data - EM algorithm, Reinforcement learning,

Unit V Pattern Recognition : Introduction, Design principles of pattern recognition system, Statistical Pattern recognition, Parameter estimation methods - Principle Component Analysis (PCA) and Linear Discriminant Analysis (LDA), Classification Techniques – Nearest Neighbor (NN) Rule, Bayes Classifier, Support Vector Machine (SVM), K – means clustering.

Text books:

1. Stuart Russell, Peter Norvig, “Artificial Intelligence – A Modern Approach”, Pearson Education

2. Elaine Rich and Kevin Knight, “Artificial Intelligence”, McGraw-Hill

3. E Charniak and D McDermott, “Introduction to Artificial Intelligence”, Pearson Education

4. Dan W. Patterson, “Artificial Intelligence and Expert Systems”, Prentice Hall of India,

OE-EE 701	Machine learning and Python Programming	L-T-P-C: 3-0-0-3
Course Outcomes: At the end of this course students will demonstrate the ability to		
CO1	Do progamming with Python	
CO2	Apply Statistics to machine learning and know how it is different than descriptive statistics	
CO3	Build features that meet analysis needs and understand different approaches for creating predictive models	
CO4	Create and evaluate data clusters	
CO5	Apply Python for NLP	

UNIT I Python Fundamentals

The basic foundation of variables– Data types – Arithmetic, logical and comparison operator – Data types of Python List – Data Cleansing – Dictionary– Conditional and Iterative loops - Numpy Library - Data Manipulation using Pandas Library - Data Visualization - visualizations using Matplotlib and Seaborn Python libraries – Merging multiple datasets - Melting/changing dimensions of datasets

UNIT II Fundamentals of Statistics

Graphically Displaying Single Variable -Measures of Location - Measures of Spread - Displaying relationship – Bivariate Data – Scatterplot - Measures of association of two or more variables - Covariance and Correlation - Probability - Joint Probability and independent events - Conditional probability - Bayes' Theorem - Prior, Likelihood and Posterior - Discrete Random Variable - Probability Distribution of Discrete Random Variable - Binomial Distribution - Continuous Random Variables - Probability Distribution Function - Uniform Distribution - Normal Distribution - Point Estimation – Interval Estimation - Hypothesis Testing

UNIT III Machine learning with Python

Supervised and Unsupervised Learning - Python libraries suitable for Machine Learning
Regression – Features and Labels– Training and Testing– Forecasting and Predicting– Theory and how it works– to program Best Fit Slope – to program the Best Fit Line– R Squared and Coefficient of Determination Theory - Model evaluation methods
Classification: Applying K Nearest Neighbors to Data -Euclidean Distance theory -Decision Trees - Regression Trees - Random Forests - Boosting Algorithm - Principal Component Analysis - Linear Discriminant Analysis
Support Vector Machine Fundamentals - Constraint Optimization with Support Vector Machine - SVM Optimization in Python - Visualization and Predicting with our Custom SVM - Kernels - Soft Margin Support Vector Machine

UNIT IV Clustering

Handling Non-Numerical Data for Machine Learning - K-Means with Titanic Dataset - K-Means in Python - Hierarchical Clustering with Mean Shift Introduction - Naive Bayes Classifier - Naive Bayes Classifier with Scikit - Introduction into Text Classification using Naive Bayes - Python Implementation of Text Classification

UNIT V Introduction to NLP

Text Pre-processing, Noise Removal, Lexicon Normalization, Lemmatization, Stemming, Object Standardization- Text to Features (Feature Engineering on text data)-Syntactical Parsing, Dependency Grammar- Part of Speech Tagging - Entity Parsing- Phrase Detection - Named Entity Recognition - Topic Modelling - N-Grams - Statistical features - TF – IDF- Frequency / Density Features: Readability Features, Word Embedding

Important tasks of NLP: Text Classification, Text Matching, Levenshtein Distance, Phonetic Matching, Flexible String Matching - Important NLP libraries

Reference Books:

1. Introduction-to-Machine-Learning-with-Python, Andreas C. Muller and Sarah Guido, O'Reilly Books
2. Beginning Programming with Python For Dummies, John Paul Mueller

OEEE-702	Embedded Systems	L-T-P-C: 3-0-0-3
Course Outcomes: At the end of this course students will demonstrate the ability to		
CO1	Choose between design approaches using advanced controllers to real-life situations	
CO2	Design interfacing of the systems with other data handling / processing systems	
CO3	Appreciate engineering constraints like energy dissipation, data exchange speeds etc	
CO4	Understand software aspects of Embedded Systems	

UNIT I

The concept of embedded systems design, Embedded microcontroller cores, embedded memories. Examples of embedded systems.

UNIT II

Technological aspects of embedded systems: interfacing between analog and digital blocks, signal conditioning, digital signal processing.

UNIT III

Sub-system interfacing, interfacing with external systems, user interfacing

Design tradeoffs due to process compatibility, thermal considerations, etc.,

UNIT IV

Software aspects of embedded systems: real time programming languages and operating systems for embedded systems.

Text/Reference Books:

1. J.W. Valvano, "Embedded Microcomputer System: Real Time Interfacing", Brooks/Cole, 2000.

2. Jack Ganssle, "The Art of Designing Embedded Systems", Newness, 1999.

3. V.K. Madisetti, "VLSI Digital Signal Processing", IEEE Press (NY, USA), 1995.

4. David Simon, "An Embedded Software Primer", Addison Wesley, 2000.

5. K.J. Ayala, "The 8051 Microcontroller: Architecture, Programming, and Applications", Penram Intl, 1996.

OPEN ELECTIVE –IV

OEC	REMOTE SENSING AND GIS APPLICATION	OE-CE 801	3 0 0	3 CREDITS

COURSE OUTCOMES:	
CO1	Retrieve the information content of remotely sensed data
CO2	Understand characteristics of multi concept of remote sensing.
CO3	Interpret the images for preparation of thematic maps.
CO4	Understand the concept & terminology of GIS.
CO5	Apply the RS & GIS in real world problems.

Unit I

Remote Sensing: Introduction, sources of energy for remote sensing, active and passive sources, electromagnetic radiation, and their characteristics, thermal emission, Interaction of EMR with atmosphere, atmospheric windows, interaction of EMR with earth surface- spectral reflection curves.

Unit II

Multi concept of remote sensing, idealisms and real sequence of remote sensing, sensors and orbital characteristics, various sensing platforms for remote sensing, characteristics of various satellite, remote sensing data products and their uses.

Unit III

Digital image processing: Introduction, digital image representation, and Characterization, histograms and scatter plot, image enhancement, contrast stretching, Pattern recognition, and feature extraction, image classification: unsupervised and Supervised techniques

Unit IV

Geographic Information system: Introduction, concept and terminology, components of GIS, raster and Vector formats, scanners and digitizers, methods of digitization, data Preprocessing, form conversion, data reduction, and generalization

Unit V

Data merging, edge matching, registration and re-sampling, data manipulation and Analysis representation of real-world problems, problem solving and spatial modeling, classification, aggregation, overlay, buffers and indivisibility and its applications in planning of utility lines, flood studies, ground water recharge, erosion modeling,

References:

1. Remote Sensing and Image Interpretation – Lillesand and Kiefer, John Wiley & Sons Ltd.
2. Introduction to the physics and techniques of Remote Sensing – Elachi, John Wiley & Sons Ltd.
3. Geographical Information System Vol. I and II– Longley, John Wiley & Sons Ltd.
4. An Introduction to GIS – Ian Haywood, Dorlling Kindersley Pvt. Ltd.
5. Advanced Surveying by Satheesh, G., Sathikumar, R., and Madhu, N., Pearsons Educations

OEC	INFRASTRUCTURE ENGINEERING	OE-CE802	3 0 0	3 CREDITS

COURSE OUTCOMES:	
CO1	Identify the elements of Building.
CO2	Identify waste water & water supply sources.
CO3	Understand about transportation infrastructure (Road, rail and air).
CO4	Analysis the various characteristics of Dam, Canal, Port, Hourber and Hydroelectric projects.
CO5	Introduction to architecture, land use planning.

Unit I

Building-

Elements- slab, beam, column, footing Types- Residential, Institutional, Commercial, Industrial Types of structure- Load bearing, framed, combined

Unit II
Water Supply and Wastewater Infrastructure

Water Supply- Source, demand, intake, transport, conduits, treatment, distribution, household plumbing
Waste Water- Collection, transport, treatment and disposal

Unit III
Transport Infrastructure: Road, rail and air

Road- Elements, types, traffic studies Rail- Gauge, components Air- Runway, planning, helipad

Unit IV
Irrigation, hydropower and navigation

Dam, canal, port, harbor, hydroelectric projects

Unit V Miscellaneous
Introduction to architecture, land use planning

References:

1. Peurify, RL, –Construction, Planning, Equipment and Methodsl, Tata McGraw Hill Education
2. NPTEL E Learning course on Infrastructure Planning &Mangament.

OEC	Structural Dynamics	OE-CE 803	3 0 0	3 CREDITS

COURSE OUTCOMES:	
CO1	Understand the characteristics of earthquake.
CO2	Understand the degree of freedom.
CO3	Understand the theory of seismic
CO4	Identify the two degree and multi degree freedom system.
CO5	Understand the various techniques of structural analysis

Unit I

Introduction: origin of earthquakes, magnitude, intensity, ground motions, sensors, strong motion characteristics. Theory of Vibrations: Introduction, Vibrations, Periodic motion, Earthquake loading on structures, structural idealization for dynamic analysis, free and forced vibrations of single degree, two degree and multi-degree freedom systems

Unit II

Single degree of freedom systems: equation of motion, free and forced vibrations, damping, response spectrum

Unit III

Theory of Seismic Pickups. Numerical Evaluation of Dynamic Response

Unit IV

Two degree and multidegree freedom systems

Unit V

Lagrange‘s equations and its applications, seismic coefficient method and average response spectrum techniques in structural analysis.

References

1. Agarwal, P. and Shrikhande, M., Earthquake resistant design of structures‖, PHI Publ. 2. Paz, M.,‖Structural dynamics – theory & computation‖, CBS Publs. 3. Chopra, A.K.,‖ Dynamics of structures theory and application of earthquake engineering‖, Prentice Hall 4. IS:1893 (Part-1) 5. IITK-BMTPC Earthquake tips

OE-EC 801 Advance Sensors and Transducers

L-T-P-C
4-0-0-4

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

1. Apply the mathematical knowledge and science & engineering fundamentals gained to solve problems pertaining to measurement applications.
2. Analyze the problems related to sensors & transducers.
3. Select the appropriate sensor/transducer for a given application.
4. Determine the static and dynamic characteristics of transducers using software packages.
5. Understand fiber optic sensor and applications. Ability to understand smart traducer and its standard.

Unit-1 (8 Hrs)
Science of measurements and classification of transducers: Units and standards, Static calibration, Classification of errors, Limiting error and probable error, Error analysis, Statistical methods , Odds and uncertainty, Classification of transducers, Selection of transducers.

Unit-2 (8 Hrs)
Characteristics of transducers: Static characteristics, Accuracy, precision, resolution, sensitivity, linearity, span and range. Dynamic characteristics, Mathematical model of transducer, Zero, I and II order transducers.

Unit-3 (8 Hrs)
Variable resistance transducers: Principle of operation, construction details, characteristics and applications of potentiometer, strain gauge, resistance thermometer, Thermistor, hot-wire anemometer, piezo-resistive sensor and humidity sensor.

Unit-4 (8 Hrs)
Variable inductance and variable capacitance transducers: Inductive transducers, Principle of operation, construction details, characteristics and applications of LVDT, capacitive transducers, characteristics of capacitive transducers, Different types, Signal Conditioning, Applications, Capacitor microphone, Capacitive pressure sensor, Proximity sensor.

Unit-5 (8 Hrs)
Other transducers: Piezoelectric transducer, Hall Effect transducer, Magneto elastic sensor, Digital transducers, Fiber optic sensors, Thick & Thin Film sensors (Bio sensor & Chemical Sensor), Environmental Monitoring sensors (Water Quality & Air pollution), Introduction to Smart transducers and its applications.

Text/ Reference Books:

1. D. Patranabis, Sensors and Transducers, Prentice Hall of India.
2. Ian Sinclair, Sensors and Transducers, Elsevier.
3. Murthy, D.V.S., Transducers and Instrumentation, Prentice Hall of India.

OE-EC 802 Multimedia Communication

L-T-P-C
4-0-0-4

Course Outcomes: After completing this course the students will have the ability to:

1. Understand different types of media for information representation and Communication; representation of multimedia information in applications.
2. Interpret and process multimedia information as per requirement for society considering ethical issues.
3. Analyze and represent sound, speech, images, videos and also to store and communicate these efficiently.
4. Processing and transforming multimedia information as per requirement. Understanding and using standards for multimedia information.

Unit-1 (18 Hrs)

Multi-Dimensional Signals: Multi Dimensional signals-Finite Extent Signals and Periodic signals, Symmetric signals, special multi dimensional signals; Multi Dimensional Transforms-Fourier Transform, DFT, DCT;

Unit-2 (6 Hrs)

Multi Dimensional systems:-Impulse response and 2D convolution, Frequency response, FIR Filters and symmetry, IIR filters and partial difference equations, 2D sampling and reconstruction, Image digitization, Digital Image representation and storage, Pixels and its neighbors.

Unit-3 (9 Hrs)

Human Visual System and Color: Color Vision and Models, Contrast Sensitivity, Spatio-Temporal Frequency Response, Stereo/Depth Perception, Analog Video, Progressive vs. Interlaced Scanning, Analog-Video Signal Formats, Analog-to-Digital Conversion, Digital Video, Spatial Resolution and Frame Rate, Color, Dynamic Range, and Bit-Depth, Color Image Processing, Digital-Video Standards.

Unit-4 (10 Hrs)

Image Filtering: Image Smoothing, Linear Shift-Invariant Low-Pass Filtering; Image Enhancement, Pixel-Based Contrast Enhancement, Spatial Filtering for Tone Mapping and Image Sharpening, Image Denoising, Image and Noise Models, Linear Space-Invariant Filters in the DFT Domain, Local Adaptive Filtering, Nonlinear Filtering: Order-Statistics.

Unit-5 (9 Hrs)

Video Filtering: Theory of Spatio-Temporal Filtering, Frequency Spectrum of Video, Motion-Adaptive Filtering, Motion-Compensated Filtering, Video-Format Conversion, Down-Conversion, De-Interlacing, Frame-Rate Conversion, Multi-Frame Noise Filtering, Motion-Adaptive Noise Filtering, Motion-Compensated Noise Filtering.

Text/Reference Books:

1. R.C. Gonzalez and R.E. Woods, Digital Image Processing, 3rd Edition, Pearson Education, 2016.
2. Anil Kumar Jain, Fundamentals of Digital Image Processing, Pearson Education, 2015.

Power Plant Engineering (OE-ME 801)

L T P C

3 1 0 4

Prerequisite: Basic Knowledge of Thermodynamics and I C Engines.

Course outcomes (COs):

1. Understand the basics of power plants.
2. Analyze the working and layout of the of steam power plant.
3. Define the working principles of Diesel power plant, its layout, safety principles and compare it with other types of plants.
4. Discuss the working principle and basic components of the nuclear power plants and Hydro-electric power plants and safety precautions involved with it.
5. Discuss and analyze the mathematical and working principle of different electrical equipment involved in the generation of the power.

Course Contents:

Unit I

Introduction: Power and energy, sources of energy, review of thermodynamic cycles related to power plants, fuels and combustion calculations. Load estimation, load curves, various terms and factors involved in power plant calculations. Effect of variable load on power plant operation, Selection of power plant units.Power plant economics and selection.Effect of plant type on costs, rates, fixed elements, energy elements, customer elements and investor's profit; depreciation and replacement, theory of rates.Economics of plant selection, other considerations in plant selection.

Unit II

Steam power plant: General layout of steam power plant, Power plant boilers including critical and super critical boilers. Fluidized bed boilers, boilers mountings and accessories, Different systems such as coal handling system, pulverizes and coal burners, combustion system, draft, ash handling system, Dust collection system, Feed water treatment and condenser and cooling towers and cooling ponds, Turbine auxiliary systems such as governing, feed heating, reheating, flange heating and gland leakage. Operation and maintenance of steam power plant, heat balance and efficiency, Site selection of a steam power plant.

Unit III

Diesel power plant: General layout, Components of Diesel power plant, Performance of diesel power plant, fuel system, lubrication system, air intake and admission system, supercharging system, exhaust system, diesel plant operation and efficiency, heat balance, Site selection of diesel power plant, Comparative study of diesel power plant with steam power plant. Gas turbine power plant: Layout of gas turbine power plant, Elements of gas turbine power plants, Gas turbine fuels, cogeneration, auxiliary systems such as fuel, controls and lubrication, operation and maintenance, Combined cycle power plants, Site selection of gas turbine power plant, Integrated Gasifier based Combined Cycle (IGCC) systems.

Unit IV

Nuclear power plant: Layout and subsystems of nuclear power plants, Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANDU Reactor, Pressurized Heavy Water Reactor (PHWR), Fast Breeder Reactors (FBR), gas cooled and liquid metal cooled reactors, safety measures for nuclear power plants. Hydroelectric and Non-Conventional Power Plant: Hydroelectric power plants, classification, typical layout and components, principles of wind, tidal, solar PV and solar thermal, geothermal, biogas and fuel cell power systems.

Unit V

Electrical system: Generators and generator cooling, transformers and their cooling, bus bar, etc. Energy Saving and Control: Energy, economic and environmental issues, power tariffs, load distribution parameters, load curve, capital and operating cost of different power plants, pollution control technologies including waste disposal options for coal and nuclear plants.

Text Books:

1. Power Plant Engineering by P.K. Nag, Tata McGraw Hill.
2. Steam & Gas Turbines & Power Plant Engineering by R. Yadav, Central Pub. House.
3. Power Plant Engineering by Gupta, PHI India.

Reference Books:

1. Power Plant Engineering, by F.T. Morse, Affiliated East-West Press Pvt. Ltd.
2. Power Plant Engineering by Hedge, Pearson India.
3. Power Plant Technology, by Wakil, McGraw Hill.
4. Power Plant Engineering. Mahesh Verma, Metropolitan Book Company Pvt. Ltd.

Optimization Method in Engineering (OE-ME 802)

L T P C

3 1 0 4

Prerequisite: Course on calculus, matrix

Course Outcomes (COs):

After completion of the course a student will be able:

1. Learn one dimensional optimization methods.
2. Learn constrained optimization of multi-variable function.
3. Apply integer programming methods.
4. Dynamic programming and operation research problems
5. Learn soft computing based optimization.

Course Contents:

Unit I

Unconstrained Optimization: Optimizing Single-Variable Functions, Conditions for Local Minimum and Maximum, Optimizing Multi-Variable Functions.

Unit II

Constrained Optimization: Optimizing Multivariable Functions with Equality Constraint: Direct Search Method, Lagrange Multipliers Method, Constrained Multivariable Optimization with inequality constrained: Kuhn-Tucker Necessary conditions, Kuhn –Tucker Sufficient Conditions.

Unit III

Optimization: Quasi-Newton Methods and line search, least squares optimization, Gauss Newton, Extensions of LP to Mixed Integer Linear Programming (MILP), Non-Linar Programming, The Newton Algorithm, Non-Linear Least Squares, Sequential Quadratic Programming (SQP), Constrained Optimization, Multi-Objective Optimization, Branch and Bound Approaches.

Unit IV

Optimization in Operation Research: Dynamic Programming, Minimax and Maximax Algorithm, Discrete Simulation, Integer Programming – Cutting Plane Methods, Separable Programming, Goal Programming, Integer Linear Programming.

Unit V

Soft computing based optimization, Practical aspects of optimization.

Text books:

1. Engineering Optimization Theory and Practice by Rao S.S.
2. Methods of Optimization by Walsh G R.
3. Integer and Combinational Optimization by G.L.Nemhauser and L.A.Wolsey.
4. Operations Research: Applications and Algorithms by Winston W L

Reference books:

1. Model Building in Mathematics Programming by Williams H.P.
2. Integer and Combinational Optimization by G.L.Nemhauser and L.A.Wolsey
3. Discrete Optimization by R.G. Parker and R.L. Rardin.
4. Combinational Optimization: Algorithms and Complexity by C.H. Papadimitrious and K.Stegilite
5. Multi-objective evolutionary optimization for Product Design and Manufacturing by LihuiWang
6. Genetic Algorithms by Kalyanmoy Deb
7. Genetic Algorithms in search, optimization and machine learning by David E Goldberg, Pearson Springer.

Fracture Mechanics (OE-ME 803)

L T P C

3 1 0 4

Prerequisite: Basic Knowledge of Mechanics of Solids and Theory of Elasticity.

Course Outcomes (COs):

1. Basic Understanding of Crack in a Structure, Fracture Toughness, Types of Fracture.
2. Analyze elastic and elastic-plastic stress fields at the crack-tip in a solid material..
3. Estimate crack growth based on energy balance.
4. Demonstrate standard fracture mechanics tests for finding J-Integral and Crack Opening Displacement.
5. Inspect a solid material for the presence of crack.

Course Contents:

Unit I

Introduction: A Crack in a Structure, Fracture Toughness. Micro and Macro Phenomena of Fracture - Microscopic Aspects: Surface Energy, Theoretical Strength, Microstructure and Defects, Crack Formation - Macroscopic Aspects: Crack Growth, Types of Fracture, Mechanisms of Fracture and Crack Growth - Cleavage Fracture, Ductile Fracture, Fatigue Cracking, Environment Assisted Cracking, Creep Fracture, Service Failure Analysis

Unit II

Linear Elastic Stress Fields in Cracked Bodies • Introduction • Crack Deformation Modes and Basic Concepts, Westergaard Method, Singular Stress and Displacement Fields,Stress Intensity Factor Solutions,Three-Dimensional Cracks

Linear Elastic-Plastic Stress Fields in Cracked Bodies: Approximate Determination of the Crack-Tip Plastic Zone, Irwin's Model, Dugdale's Model

Unit III

Crack Growth Based on Energy Balance: Introduction, Energy Balance During Crack Growth, Griffith Theory, Graphical Representation of the Energy Balance Equation, Equivalence between Strain Energy Release Rate and Stress Intensity Factor, Compliance, Crack Stability.

Unit IV

Fracture Criteria: Critical Stress Intensity Factor Fracture Criterion, J-Integral and Crack Opening Displacement Fracture Criteria, Strain Energy Density Failure Criterion: Mixed-Mode Crack Growth.

Dynamic Fracture Introduction, Mott's Model , Stress Field around a Rapidly Propagating Crack , Strain Energy Release Rate, Crack Branching, Crack Arrest ,Experimental Determination of Crack Velocity and Dynamic Stress Intensity

Unit V

Introduction to Fatigue Fracture, Environment-Assisted Fracture, Creep Fracture and Crack Detection Methods such as Dye Penetration, Magnetic Particles, Eddy Current, Radiography, Ultrasonic, and Acoustic Emission**.**

Text Books:

1. Prashant Kumar, "Elements of Fracture Mechanics", Tata McGraw Hill Education Pvt. Ltd.
2. T.L. Anderson, "Fracture Mechanics - Fundamentals and Applications", CRC - Taylor and Francis.

Reference Books:

1. E.E. Gdoutos, "Fracture Mechanics - An Introduction", Springer.
2. D. Broek, "Elementary Engineering Fracture Mechanics", Kluwer Academic Publishers.
3. R.W. Hertzberg, "Deformation and Fracture Mechanics of Engineering Materials", Wiley India Pvt. Ltd.

Machine Tool Design (OE-ME 804)

L T P C

3 1 0 4

Prerequisite: Basic Knowledge of Workshop Technology.

Course Outcomes (COs):

After successful completion of this course students will be able to

1. Understand classification of machine tools with their nomenclature, specification and uses.
2. Explain working of various drives mounted in machine tools.
3. Analyze the speed and feed box with the regulation of speed and feed rates.
4. Design components like structural bed, column, power screws etc.
5. Apply knowledge to study dynamics of machine tool and its control.

Course Contents:

UNIT I

Introduction: Developments is machine tools, types of machine tools surface, profits and paths produced by machine tools. Features of construction and operations of basic machine tools e.g. lathe, drill, milling shapes and planers, grinding machine etc.General requirement of machine tool design.Machine tool design process. Tool wear, force Analysis.

UNIT II

Machine Tools Drives: Classification of machine tool drives, group Vs individual drives, Selection of electric motor, A brief review of the elements of mechanical transmission e.g. gear, belt and chain drives, Slider-crank mechanism, cam mechanism, nut & Screw transmission, Devices for intermittent motion, reversing & differential mechanisms. Couplings and clutches Elements of hydraulic transmission system. e.g. pumps, cylinder, directional control valves, pressure valves etc., Fundamentals of Kinematics structure of machine tools.

UNIT III

Regulation of Speed and Feed rates: Laws of stepped regulation, selection of range ratio, standardprogression ratio, selection of best possible structural diagram, speed chart, Design of feed box,developing gearing diagrams. stepless regulation of speed and feed in machine tool, speed and feedcontrol.

UNIT IV

Design of Machine Tool Structure: Requirements and design criteria for machine tool structures,selection of material Basic design procedure for machine tool structures, design of bed, column andhousing, Model technique in design.

Design of guide ways and power screws: Basic guide way profiles, designing guide way for stiffness a wear resistance, hydrostatic and antifriction grand ways. Design of sliding friction power Screws. Design of spindlier & spindle supports. Layout of bearings, selection of bearings for machine tools.

UNIT V

Dynamics of machine tools: General procedure for assessing the dynamic stability of cutting process,closed loop system, chatter in machine tools.

Control Systems: Functions, requirements & types of machine tool controls, controls for speed &feed change. Automatic and manual Controls.Basics of numerical controls.Machine tool testing.

Text Books:

1. N.K. Mehta, "Machine Tool Design and Numerical Control" Second Edition, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1984.
2. S.K. Basu and D.K. Pal, "Design of Machine Tools", Fourth Edition, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 1990.
3. G.C. Sen and A. Bhattacharya, "Principles of Machine Tools", Second Edition, New Central Book Agency (P) Ltd., Kolkata, 1988.

Reference Books:

1. F. Koenigsberger, "Design Principles of Metal Cutting and Machine Tools", Edition 1964, Pergamon Press Ltd., London.
2. H.C.Town, "The Design and Construction of Machine Tools", Central Machine Tool Research Institute, Bangalore, Machine Tool Design Handbook.
3. PSG College of Engg. & Technology, PSG Design Data Book.
4. N.K. Acherkan, "Machine Tool Design (Vol.I to Vol.IV)", Mir Publishers.

OE-CS 801	BLOCKCHAIN	3L-0T-0P	CREDIT -4

Course outcome expected:

By the end of the course the students should be able to:

CO1: To explore of blockchain and its architecture.
CO2: Understand the consensus, Consensus protocols for Permissioned Blockchains.
CO3: understand the Hyperledger Fabric and its implementation.
CO4: Applies blockchain concept in Financial Software and Systems, trade/supply chain (use cases).
CO5: Applies blockchain concept for Government(use case).

Unit-I Introduction :

Introduction to Blockchain: Digital Money to Distributed Ledgers , Design Primitives: Protocols, Security, Consensus, Permissions, Privacy. Blockchain Architecture and Design: Basic crypto primitives: Hash, Signature,) Hashchain to Blockchain, Basic consensus mechanisms

Unit-II : Consensus: Requirements for the consensus protocols, Proof of Work (PoW), Scalability aspects of Blockchain consensus protocols Permissioned Blockchains:Design goals, Consensus protocols for Permissioned Blockchains

Unit-III : Hyperledger Fabric (A): Decomposing the consensus process , Hyperledger fabric components, Chaincode Design and Implementation Hyperledger Fabric (B): Beyond Chaincode: fabric SDK and Front End (b) Hyperledger composer tool

Unit-IV: Use case 1 : Blockchain in Financial Software and Systems (FSS): (i) Settlements, (ii) KYC, (iii) Capital markets, (iv) Insurance Use case 2: Blockchain in trade/supply chain: (i) P Provenance of goods, visibility, trade/supply chain finance, invoice management discounting, etc

Unit-V Use case 3: Blockchain for Government: (i) Digital identity, land records and other kinds of record keeping between government entities, (ii) public distribution system social

Text Books:

1. Mstering Bitcoin: Unlocking Digital Cryptocurrencies, by Andreas Antonopoulos
2. Blockchain by Melanie Swa, O'Reilly
3. Hyperledger Fabric - https://www.hyperledger.org/projects/fabric
4. Zero to Blockchain - An IBM Redbooks course, by Bob Dill, David Smits - https://www.redbooks.ibm.com/Redbooks.nsf/RedbookAbstracts/crse0401.html

OE-CS 802	Computer Vision	3L-0T-0P	CREDIT -4

Course outcome expected:

By the end of the course the students should be able to:

CO1: To explore fundamental image processing techniques required for computer vision
CO2: Understand Image formation process and Generate 3D model from images.

CO3: Perform feature extraction and motion estimation on the images.

CO4: To perform shape analysis and perform segmentation.

CO5: Perform Object Analysis and do processing.

Unit-I Introduction :

Image Processing, Computer Vision and Computer Graphics , What is Computer Vision - Low-level, Mid-level, High-level , Overview of Diverse Computer Vision Applications: Document Image Analysis, Biometrics, Object Recognition, Tracking, Medical Image Analysis, Content-Based Image Retrieval, Video Data Processing, Multimedia, Virtual Reality and Augmented Reality.

Unit-II : Image Formation Models : Monocular imaging system , Radiosity: The 'Physics' of Image Formation, Radiance, Irradiance, BRDF, color etc, Orthographic & Perspective Projection,• Camera model and Camera calibration, Binocular imaging systems, Multiple views geometry, Structure determination, shape from shading , Photometric Stereo, Depth from Defocus , Construction of 3D model from images.

Unit-III :

Image Processing , Feature Extraction and Motion Estimation : Image preprocessing, Image representations (continuous and discrete) , Edge detection, Regularization theory , Optical computation , Stereo Vision , Motion estimation , Structure from motion

Unit-IV :

Shape Representation and Segmentation : Contour based representation, Region based representation, Deformable curves and surfaces , Snakes and active contours, Level set representations , Fourier and wavelet descriptors , Medial representations , Multiresolution analysis.

Unit-V

Object recognition and Image understanding: Hough transforms and other simple object recognition methods, Shape correspondence and shape matching, Principal component analysis , Shape priors for recognition, Pattern recognition methods, HMM, GMM and EM.

Text Books:

1. Computer Vision - A modern approach, by D. Forsyth and J. Ponce, Prentice Hall Robot Vision, by B. K. P. Horn, McGraw-Hill
2. Introductory Techniques for 3D Computer Vision, by E. Trucco and A. Verri, Publisher: Prentice Hall.
3. R. C. Gonzalez, R. E. Woods. Digital Image Processing. Addison Wesley Longman, Inc., 1992
4. D. H. Ballard, C. M. Brown. Computer Vision. Prentice-Hall, Englewood Cliffs, 1982.

OE-EE 801	Metro Systems and Engineering	L-T-P-C: 3-0-0-3
Course Outcomes: At the end of this course students will demonstrate the ability to		
CO1	Understand the basic plan of metro systems	
CO2	Aware of the construction methods, quality and safety systems	
CO3	Comprehend the SCADA based signalling system	
CO4	Understand vehicle dynamics, ventilation, fire safety	
CO5	Relate with the Power Supply and Back-up systems	

UNIT I GENERAL

Overview of Metro Systems; Need for Metros; Routing studies; Basic Planning and Financials

UNIT II CIVILENGINEERING

Overview and construction methods for: Elevated and underground Stations; Viaduct spans and bridges; Underground tunnels; Depots; Commercial and Service buildings. Initial Surveys & Investigations; Basics of Construction Planning & Management, Construction Quality & Safety Systems - Traffic integration, multimodal transfers and pedestrian facilities; Environmental and social safeguards; Track systems-permanent way. Facilities Management

UNIT III ELECTRONICS AND COMMUNICATION ENGINEERING

Signaling systems; Automatic fare collection; Operation Control Centre (OCC and BCC); SCADA and other control systems; Platform Screen Doors

UNIT IV MECHANICAL & TV + AC:

Rolling stock, vehicle dynamics and structure; Tunnel Ventilation systems; Air conditioning for stations and buildings; Fire control systems; Lifts and Escalators

UNIT V ELECTRICAL:

OHE, Traction Power; Substations- TSS and ASS; Power SCADA; Standby and Back-up systems; Green buildings, Carbon credits and clear air mechanics**.**

Reference Books:

1. Railway Engineering, Rangwala, Charotat Publishing
2. Civil Engineering for Underground Rail Transport, J.T. Edwards, Science Direct
3. **http://www.railsystem.net/electric-traction-systems/**

OE-EE 802	Speech and Audio Processing	L-T-P-C: 3-0-0-3
Course Outcomes: At the end of this course students will demonstrate the ability to		
CO1	Mathematically model the speech signal	
CO2	Analyze the quality and properties of speech signal	
CO3	Modify and enhance the speech and audio signals	

UNIT I

Introduction- Speech production and modeling - Human Auditory System; General structure of speech coders; Classification of speech coding techniques – parametric, waveform and hybrid ; Requirements of speech codecs –quality, coding delays, robustness.

UNIT II

Speech Signal Processing- Pitch-period estimation, all-pole and all-zero filters, convolution; Power spectral density, periodogram, autoregressive model, autocorrelation estimation.

Linear Prediction of Speech- Basic concepts of linear prediction; Linear Prediction Analysis of non-stationary signals –prediction gain, examples; Levinson-Durbin algorithm; Long term and short-term linear prediction models; Moving average prediction.

UNIT III

Speech Quantization- Scalar quantization–uniform quantizer, optimum quantizer,logarithmicquantizer, adaptive quantizer, differential quantizers; Vector quantization – distortion measures, codebook design, codebook types.

Scalar Quantization of LPC- Spectral distortion measures, Quantization based onreflection coefficient and log area ratio, bit allocation; Line spectral frequency – LPC to LSF conversions, quantization based on LSF.

UNIT IV

Linear Prediction Coding- LPC model of speech production; Structures of LPCencoders and decoders; Voicing detection; Limitations of the LPC model.

UNIT V

Code Excited Linear Prediction-CELP speech production model; Analysis-by-synthesis; Generic CELP encoders and decoders; Excitation codebook search – state-save method, zero-input zero-state method; CELP based on adaptive codebook, Adaptive Codebook search; Low Delay CELP and algebraic CELP.

Speech Coding Standards-An overview of ITU-T G.726, G.728 and G.729standards

Text/Reference Books:

1. “Digital Speech” by A.M.Kondoz, Second Edition (Wiley Students‟ Edition), 2004.

2. “Speech Coding Algorithms: Foundation and Evolution of Standardized Coders”, W.C. Chu, WileyInter science, 2003.