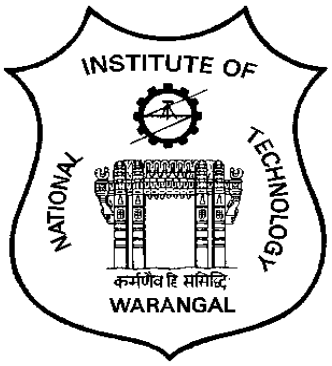
NATIONAL INSTITUTE OF TECHNOLOGY WARANGAL



SCHEME OF INSTRUCTION AND SYLLABI

FOR

B.TECH PROGRAM IN CIVIL ENGINEERING

Effective from 2014-15

DEPARTMENT OF CIVIL ENGINEERING

NATIONAL INSTITUTE OF TECHNOLOGY WARANGAL

VISION

Towards a Global Knowledge Hub, striving continuously in pursuit of excellence in Education, Research, Entrepreneurship and Technological services to the society

MISSION

- Imparting total quality education to develop innovative, entrepreneurial and ethical future professionals fit for globally competitive environment.
- Allowing stake holders to share our reservoir of experience in education and knowledge for mutual enrichment in the field of technical education.
- Fostering product oriented research for establishing a self-sustaining and wealth creating centre to serve the societal needs.

DEPARTMENT OF CIVIL ENGINEERING

VISION

To be a knowledge nerve centre in civil engineering education, research, entrepreneurship and industry outreach services for creating sustainable infrastructure and enhancing quality of life.

MISSION

- Generate a specialized cadre of civil engineers by imparting quality education and training
- Attain international standards in teaching, research and consultancy with global linkages

GRADUATE ATTRIBUTES

The Graduate Attributes are the knowledge skills and attitudes which the students have at the time of graduation. These attributes are generic and are common to all engineering programs. These Graduate Attributes are identified by National Board of Accreditation.

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, 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 modelling 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.

DEPARTMENT OF CIVIL ENGINEERING

B.TECH IN CIVIL ENGINEERING

PROGRAM EDUCATIONAL OBJECTIVES

PEO1	Apply principles of basic and engineering sciences in analysis, design and operation of civil engineering systems.
PEO2	Assess societal needs and plan suitable infrastructure
PEO3	Analyze and design components of civil engineering projects
PEO4	Develop team spirit and inter personal dynamics for effective execution and management of projects.
PEO5	Engage in lifelong learning and adapt to changing professional and societal needs.

Mapping of mission statements (MS) with program educational objectives (PEOs)

	PEO1	PEO2	PEO3	PEO4	PEO5
MS1	3	3	3	2	1
MS2	2	2	2	1	2

1: Slightly 2: Moderately 3: Substantially

Mapping of Program Educational Objectives (PEOs) with Graduate Attributes (GAs)

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
PEO1	3	3	3	3	3	-	-	-	-	-	-	2
PEO2	1	2	3	2	2	3	3	3	-	-	-	2
PEO3	2	2	3	2	2	1	2	3	2	3	3	2
PEO4	-	1	2	2	3	3	3	3	3	3	3	2
PEO5	2	3	3	3	2	1	3	3	2	3	2	3

1: Slightly 2: Moderately 3: Substantially

PROGRAM OUTCOMES: At the end of the program, the student will be able to:

PO1	Apply principles of mechanics and basic sciences to analyze civil engineering structures
PO2	Survey, map, measure and analyze data for sustainable infrastructure planning.
PO3	Characterize and evaluate materials for adoptability in civil engineering projects
PO4	Analyze and design concrete & steel structures, earthen embankments, irrigation structures, water supply, waste treatment systems and transport systems.
PO5	Apply best management practices for construction and maintenance of infrastructure facilities.
PO6	Predict and forecast societal needs, floods, droughts, pollution and travel demand.
PO7	Work and lead in multi disciplinary projects and demonstrate social responsibility and professional ethics.
PO8	Engage in research and life-long learning to adapt to changing environment.

Mapping of Program Outcomes (POs) with Program Educational Objectives (PEOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
PEO1	3	2	2	2	1	2	-	-
PEO2	1	3	3	3	3	-	-	-
PEO3	3	1	3	3	2	2	1	2
PEO4	-	-	-	1	2	-	2	2
PEO5	-	-	-	1	1	-	2	2

1: Slightly 2: Moderately 3: Substantially

Mapping of Programme Outcomes (Pos) with Graduate Attributes (GAs)

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
PO1	3	3	2	2	2	1	1	-	1	-	-	2
PO2	3	3	1	3	3	2	2	1	2	1	-	2
PO3	3	1	1	3	2	1	1	1	1	2	1	2
PO4	3	3	3	2	3	1	-	-	2	1	-	2
PO5	1	1	1	1	1	2	2	3	2	2	3	2
PO6	3	3	2	2	3	3	3	1	1	-	-	2
PO7	2	2	1	2	2	3	3	3	3	3	2	3
PO8	1	1	2	3	2	2	2	1	2	2	1	3

CURRICULAR COMPONENTS

Degree Requirements for B. Tech in Civil Engineering

Category of Courses	Credits Offered	Min. credits to be earned
Basic Science Core (BSC)	32	32
Engineering Science Core (ESC)	33	33
Humanities and Social Science Core (HSC)	07	07
Program Core Courses (PCC)	88	88
Departmental Elective Courses (DEC)	24	18
Open Elective Courses (OPC)	6	6
Program major Project (PRC)	6	**6**
EAA: Games and Sports (MDC)	0	0
Total	**196**	190

SCHEME OF INSTRUCTION

B.Tech. (Civil Engineering) Course Structure

B. Tech. I - Year I - Semester

S. No.	Course Code	Course Title	L	T	P	Credits	Cat. Code
1	MA101	Mathematics – I	4	0	0	4	BSC
2	HS101 ME102	English for Communication (or) Engineering Graphics	3 2	0 0	2 3	4 4	HSC ESC
3	PH101 CY101	Physics (or) Chemistry	4 4	0 0	0 0	4 4	BSC BSC
4	EC101 EE101	Basic Electronics Engineering (or) Basic Electrical Engineering	3 3	0 0	0 0	3 3	ESC ESC
5	CE102 ME101	Environmental Science and Engineering (or) Basic Mechanical Engineering	3 3	0 0	0 0	3 3	ESC ESC
6	CS101 CE101	Prob. Solving and Computer Programming (or)Engineering Mechanics	4 4	0 0	0 0	4 4	ESC ESC
7	PH102 CY102	Physics Lab (or) Chemistry Lab	0 0	0 0	3 3	2 2	BSC BSC
8	CS102 ME103	Prob. Solving and Computer Programming Lab(or)Workshop Practice	0 0	0 0	3 3	2 2	ESC ESC
9	EA101	EAA: Games and Sports	0	0	3	0	MDC
		TOTAL	**21**	**0**	**11**	**26**	
			20	**0**	**12**	**26**	

B.Tech. I - Year II - Semester

S. No.	Course Code	Course Title	L	T	P	Credits	Cat. Code
1	MA151	Mathematics – II	4	0	0	4	BSC
2	ME102 HS101	Engineering Graphics (or) English for Communication	2 3	0 0	3 2	4 4	ESC HSC
3	CY101 PH101	Chemistry (or) Physics	4 4	0 0	0 0	4 4	BSC BSC
4	EE101 EC101	Basic Electronics Engineering (or) Basic Electrical Engineering	3 3	0 0	0 0	3 3	ESC ESC
5	ME101 CE102	Basic Mechanical Engineering (or) Environmental Science and Engineering	3 3	0 0	0 0	3 3	ESC ESC
6	CE101 CS101	Engineering Mechanics (or) Problem Solving and Computer Programming	4 4	0 0	0 0	4 4	ESC ESC
7	CY102 PH102	Chemistry Lab (or) Physics Lab	0 0	0 0	3 3	2 2	BSC BSC
8	ME103 CS102	Workshop practice (or) Problem Solving and Computer Prog. Lab	0 0	0 0	3 3	2 2	ESC ESC
9	EA151	EAA: Games and Sports	0	0	3	0	MDC
		Total	**20**	**0**	**12**	**26**	
			21	**0**	**11**	**26**	

II - Year I - Semester

Course Code	Name of the Course	L–T–P–C	Category
MA211	Mathematical Methods	4-0-0-4	BSC
CE201	Strength of Materials	4-0-0-4	PCC
CE202	Fluid mechanics – I	4-0-0-4	PCC
CE203	Surveying	4-0-0-4	PCC
CE204	Civil Engineering Materials	3-0-0-3	PCC
CE205	Material Testing Lab	0-0-3-2	PCC
CE206	Fluid Mechanics Lab	0-0-3-2	PCC
CE207	Surveying Lab	0-0-4-3	PCC
	TOTAL	**19-0-10-26**	

II - Year II - Semester

Course Code	Name of the Course	L–T–P–C	Category
CE251	Mechanics of Materials	3-0-0-3	PCC
CE252	Fluid mechanics –II	3-0-0-3	PCC
CE253	Design of Steel Structures	4-0-0-4	PCC
CE254	Building Planning & Construction	3-0-0-3	PCC
CE255	Concrete Technology	3-0-0-3	PCC
CE256	Hydraulic Engineering Lab.	0-0-3-2	PCC
CE257	Building Drawing	0-0-3-2	PCC
CE258	Concrete Lab	0-0-3-2	PCC
	TOTAL	**16-0-9-22**	

III - Year I – Semester

Course Code	Name of the Course	L–T–P–C	Category
CE301	Theory of Structures-I	4-0-0-4	PCC
CE302	Design of Concrete Structures	4-0-0-4	PCC
CE303	Engineering Hydrology	4-0-0-4	PCC
CE304	Geotechnical Engineering – I	4-0-0-4	PCC
CE305	Engineering Geology	3-0-0-3	PCC
SM311	Engineering Economics & Accountancy	3-0-0-3	HSC
CE306	Geotechnical Engineering Lab	0-0-3-2	PCC
CE307	Engineering Geology Lab	0-0-3-2	PCC
	TOTAL	**22-0-6-26**	

III - Year II - Semester

Course Code	Name of the Course	L–T–P–C	Category
CE351	Theory of Structures- II	3-0-0-3	PCC
CE352	Irrigation Engineering	4-0-0-4	PCC
CE353	Environmental Engineering	4-0-0-4	PCC
CE354	Transportation Engineering	4-0-0-4	PCC
CE355	Geotechnical Engineering – II	3-0-0-3	PCC
	Open Elective-1	3-0-0-3	OPC
CE356	Environmental Engineering Laboratory	0-0-3-2	PCC
CE357	Civil Engineering Software Laboratory	0-0-3-2	PCC
	TOTAL	**21-0-6-25**	

IV - Year I - Semester

Course Code	Name of the Course	L–T–P–C	Category
CE401	Quantity Surveying and Public Works	1-0-3-3	PCC
	Open Elective – 2	3-0-0-3	OPC
	Department Elective – 1	3-0-0-3	DEC
	Department Elective – 2	3-0-0-3	DEC
	Department Elective – 3	3-0-0-3	DEC
	Department Elective – 4	3-0-0-3	DEC
CE402	Transportation Engineering Lab	0-0-3-2	PCC
CE449	Project Work Part – A	0-0-3-2	PRC
	TOTAL	**16-0-9-22**	

IV - Year II – Semester

Course Code	Name of the Course	L–T–P–C	Category
CE451	Construction Technology & Project Management	3-0-0-3	PCC
EE480	Measurement Techniques & Instrumentation Engineering	3-0-0-3	ESC
	Department Elective – 5	3-0-0-3	DEC
	Department Elective – 6	3-0-0-3	DEC
	Department Elective – 7	3-0-0-3	DEC
	Department Elective – 8	3-0-0-3	DEC
CE491	Seminar	0-0-2-1	MDC
CE499	Project Work – Part B	0-0-6-4	PRC
	TOTAL	**18-0-8-23**	

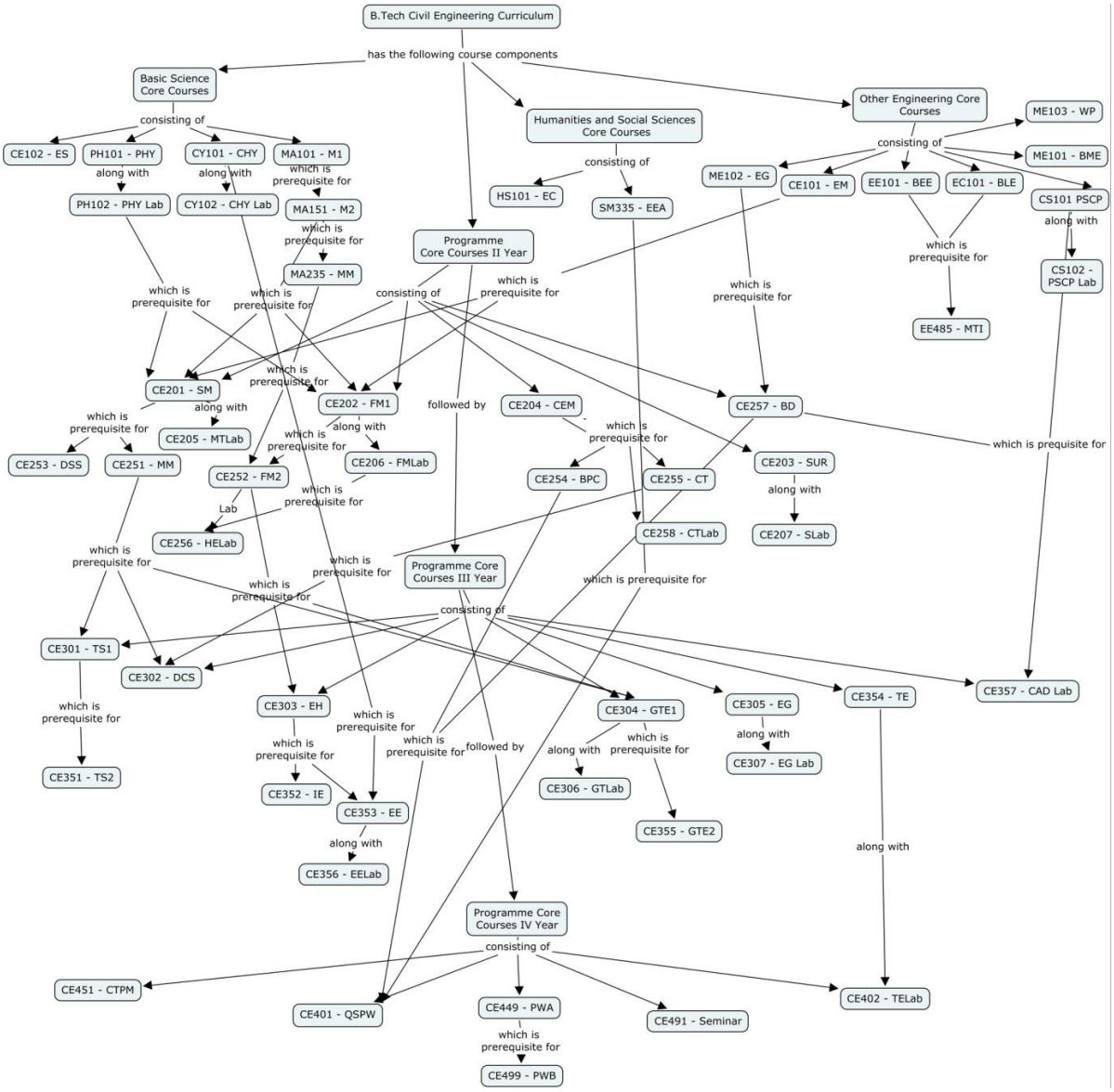
List of Electives

Department Electives – 1, 2, 3 & 4	
Course Code	Name of the Course
CE411	Prestressed Concrete
CE412	Industrial Structures
CE413	Applied Stress Analysis
CE414	Structural Dynamics
CE415	Bridge Engineering
CE416	Computational Hydraulics
CE417	Stochastic Hydrology
CE418	Industrial Waste Treatment
CE419	Air Pollution
CE420	Irrigation Management
CE421	Design of Hydraulic Structures
CE422	Systems Analysis in Civil Engineering
CE423	Machine Foundations
CE424	Foundation Analysis and Design
CE425	Ground Improvement Techniques
CE426	Rock Engineering & Underground Structures
CE427	Remote Sensing
CE428	Advanced Surveying
CE429	Pavement Engineering
CE430	Low Volume Roads
CE431	Railway Engineering
CE432	Traffic Engineering

Department Electives – 5, 6, 7, & 8	
Course code	**Name of the Course**
CE461	Design of Earthquake Resistant Structures
CE462	Advanced RC Design
CE463	Repair and Rehabilitation of Structures
CE464	Finite Element Analysis
CE465	Environmental Modelling
CE466	Environmental Impact Analysis
CE467	Water Resource Systems
CE468	Ground Water Development
CE469	Hydro Power Engineering
CE470	Watershed Management
CE471	Solid Waste Management
CE472	Environmental Geotechnical Engineering
CE473	Earthquake Geotechnical Engineering
CE474	Geosynthetics
CE475	GPS
CE476	Geographical Information Systems
CE477	Air and Water Transportation
CE478	Travel Demand Analysis
CE479	Pavement Construction & Maintenance
CE480	Highway Safety

B.TECH IN CIVIL ENGINEERING

PRE-REQUISITE CHART



DETAILED SYLLABUS

MA101	MATHEMATICS – I	BSC	4 – 0 – 0	4 Credits

Pre-requisites: None.

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

CO1	Solve linear system equation
CO2	Determine the Eigen values and vectors of a matrix
CO3	Determine the power series expansion of a function
CO4	Estimate the maxima and minima of multivariable functions
CO5	Solve any given first order ordinary differential equation
CO6	Solve any higher order linear ordinary differential equation with constant coefficients

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	2	-	-	1	-	-	-	1
CO2	2	-	-	1	-	-	-	1
CO3	1	-	-	-	-	1	-	1
CO4	2	1	-	2	1	1	-	1
CO5	2	-	-	3	-	-	-	1
CO6	1	-	-	2	-	-	-	1

Detailed Syllabus:

Matrix Theory: Elementary row and column operations on a matrix, Rank of matrix – Normal form – Inverse of a matrix using elementary operations –Consistency and solutions of systems of linear equations using elementary operations, linear dependence and independence of vectors - Characteristic roots and vectors of a matrix - Caley-Hamillton theorem and its applications, Complex matrices, Hermitian and Unitary Matrices - Reduction to diagonal form - Reduction of a quadratic form to canonical form – orthogonal transformation and congruent transformation.

Differential Calculus: Rolle's theorem; Mean value theorem; Taylor's and Maclaurin's theorems with remainders, Expansions; Indeterminate forms; Asymptotes and curvature; Curve tracing; Functions of several variables, Partial Differentiation, Total Differentiation, Euler's theorem and generalization, maxima and minima of functions of several variables (two and

three variables) – Lagrange's method of Multipliers; Change of variables – Jacobians.

Ordinary differential equations of first order: Formation of differential equations; Separable equations; equations reducible to separable form; exact equations; integrating factors; linear first order equations; Bernoulli's equation; Orthogonal trajectories and Newton's law of cooling.

Ordinary linear differential equations of higher order : Homogeneous linear equations of arbitrary order with constant coefficients - Non-homogeneous linear equations with constant coefficients; Euler and Cauchy's equations; Method of variation of parameters; System of linear differential equations, Vibrations of a beam.

Reading:

1. R.K.Jain and S.R.K.Iyengar, Advanced Engineering Mathematics, Narosa Pub. House, 2008.
2. Erwyn Kreyszig, Advanced Engineering Mathematics, John Wiley and Sons, 8th Edition, 2008.
3. B.S.Grewal, Higher Engineering Mathematics, Khanna Publications, 2009.

HS101	ENGLISH FOR COMMUNICATION	HSC	3 – 0 – 2	4 Credits

Pre-requisites: None.

Course outcomes: At the end of the course, the student will be able to:

CO1	Understand basic grammar principles
CO2	Write clear and coherent passages
CO3	Write effective letters for job application and complaints
CO4	Prepare technical reports and interpret graphs
CO5	Enhance reading comprehension
CO6	Comprehend English speech sound system, stress and intonation

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	-	-	-	-	-	-	1	-
CO2	-	-	-	-	-	-	2	2
CO3	-	-	-	-	-	-	2	1
CO4	-	-	-	-	-	-	1	1
CO5	-	-	-	-	-	-	-	1
CO6	-	-	-	-	-	-	1	1

Detailed syllabus

Grammar Principles and Vocabulary Building: -Exposure to basics of grammar- parts of speech, with emphasis on tenses—active and passive voice- their usage- reported speech - Idioms and Phrases—their meanings and usage, Vocabulary development through prefixes, suffixes and word roots

Effective Sentence Construction –clarity and precision in construction—strategies for effectiveness in writing

Paragraphs: Definition- structure- Types and Composition-unity of theme- coherence-organisation patterns

Note-making – its uses- steps in note-making—identification of important points-reduction to phrases –selection of suitable note format- types of notes—tree diagram, block list, table-

Letter Writing: Business, Official and Informal letters-- communicative purpose-strategy-letter format and mechanics- letters of request , complaint and invitation-

Reading techniques: Skimming and Scanning – quick reading for gist and –suggesting titles-looking for specific information

Description of Graphics- kinds of graphs- their construction and use and application in scientific texts- interpretation of graphs using expressions of comparison and contrast

Reading Comprehension – reading to retrieve information ––techniques of comprehension -find clues to locate important points- answering objective type questions –inference, elimination

Technical Report-Writing - kinds of reports-proposals, progress and final reports- their structure- features- process of writing a report-editing

Book Reviews- Oral and written review of a chosen novel/play- a brief written analysis including summary and appreciation- oral presentation of the novel before class

Reading

A Textbook of English for Engineers and Technologists (combined edition, Vol. 1 & 2); Orient Black Swan 2010.

PH101	PHYSICS	BSC	4 – 0 – 0	4 Credits

Prerequisites: None.

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

CO1	Solve engineering problems using the concepts of wave and particle nature of radiant energy
CO2	Understand the use of lasers as light sources for low and high energy applications
CO3	Understand the nature and characterization of acoustic design, nuclear accelerators and new materials
CO4	Apply the concepts of light in optical fibers, light wave communication systems, and holography and for sensing physical parameters
CO5	Construct a quantum mechanical model to explain the behaviour of a system at microscopic level

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	1	1	-	-	-	-	-	1
CO2	-	1	-	-	-	-	-	1
CO3	-	-	-	1	-	2	-	1
CO4	-	1	-	-	-	1	-	1
CO5	-	-	-	-	-	1	-	1

Detailed Syllabus:

Interference: Superposition principle, Division of amplitude and wave front division, Interferometers (Michelson, Fabry-Perot, Mach-Zehnder), Applications; Diffraction: Fraunhoffer diffraction (single, double & multiple slits), Resolving power, Dispersive power, Applications.

Polarization: Production & detection of polarized light, wave plates, optical activity, Laurents Half-shade polarimeter, photoelasticity and applications; LASERS: Basic principles of Lasers, He-Ne, Nd-YAG, CO_2 and semiconductors lasers, applications of lasers, Holography and holographic NDT.

Optical fibers: Light propagation in Optical fibers, types of optical fibers, optical fibers for communication and sensing.

Functional materials: Fiber reinforced plastics, fiber reinforced metals, surface acoustic wave materials, biomaterials, high temperature materials, smart materials and their applications, Introduction to Nano materials.

Modern physics: Qualitative review of different experiments, de-Broglie waves, Dual nature of matter, Schrodinger wave equation, wave function and its interpretation, potential well problems in one dimension, Tunneling, Uncertainty principle, Particle Accelerators: Cyclotron, Synchro Cyclotron, Betatron and applications.

Acoustics: Introduction, Reverberation and reverberation time, growth and decay of energy, Sabine's formula, absorption coefficient and its measurement, factors affecting architectural acoustics; Production, detection and applications of Ultrasound.

Reading:

1. Halliday, Resnic and Walker, Fundamentals of Physics, 9th Ed.,John Wiley, 2011.
2. Beiser A, Concepts of Modern Physics, 5th Ed., McGraw Hill International, 2003.
3. Ajoy Ghatak, Optics, 5th Ed., Tata McGraw Hill, 2012.
4. M. Armugam, Engineering Physics, Anuradha Agencies, 2003.

CY101	CHEMISTRY	BSC	4 – 0 – 0	4 Credits

Pre-requisites: None.

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

CO1	Understand and apply the concepts in electrochemistry and corrosion science
CO2	Understand the concepts in molecular interactions
CO3	Understand the synthesis and analysis of modern materials
CO4	Apply the concepts of organic chemistry for synthesis
CO5	Understand the synthesis and applications of polymer science
CO6	Identify the structure of organic molecules using photo chemistry and chemical spectroscopy

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	-	-	2	1	-	-	-	1
CO2	-	-	1	2	-	-	-	1
CO3	1	-	3	1	-	-	-	2
CO4	-	-	1	2	-	-	-	1
CO5	-	-	2	1	-	-	-	1
CO6	-	1	1	-	-	-	-	1

Detailed Syllabus:

Electrochemistry - Review of the concepts of electrode potentials, Nernst equation, Reference electrodes, Ion selective electrodes – Concept – Glass electrode – Determination of pH of a solution using a glass electrode – Derivation of equation between E_{cell} and pH, Determination of F^- ion using fluoride electrode (Numerical calculations), Chemically modified electrodes (CMEs) – Concept, CMEs as potentiometric and amperometric sensors, Electrochemical energy systems, Electrochemistry of secondary cells e.g. Lead – acid and Ni-Cd cells, Rechargeable lithium batteries, Fuel cells – Electrochemistry of a H_2–O_2 fuel cell, methanol–O_2 fuel cell.

Corrosion and Its Prevention - Electrochemical theory of corrosion, Corrosion due to dissimilar metal cells (galvanic cells), Corrosion due to differential aeration cells, Uniform corrosion, pitting corrosion and stress corrosion cracking, Effect of pH, Potential-pH diagram for Iron, temperature and dissolved oxygen on corrosion rate, Corrosion prevention and control by cathodic protection.

Molecular Interactions - Molecular orbital theory applicable to understanding of bonding in heteronuclear diatomic molecules, e.g. CO and NO, Molecular orbital energy diagram of an Octahedral complex, MO diagram of a molecule involving charge transfer (e.g. $KMnO_4$), Nature

of supramolecular interactions: ion-ion interactions, ion-dipole interactions, dipole-dipole interactions, hydrogen bonding, cation-л interactions, л-л interactions, van der Walls forces, Concept of self-assembly involving different types of interactions (Micellar formation; Membrane Formation; Surface films).

Chemistry of Nanomaterials - Introduction to Nanomaterials, Chemical synthesis of nanomaterials: sol-gel method, Reverse micellar method, electrolytic method, Characterization of nanoparticles by BET method, Characterization of nanomaterials by TEM (includes basic principle of TEM), Applications of nanomaterials in Industry as drug delivery materials, as catalysts, in water treatment.

Basic Principles Of Organic Chemistry – Introduction, Homolytic and Heterolytic cleavages and free radicals Carbocations, carbanions and addition reactions Elimination and substitution reactions.

Stereochemistry: chirality, optical activity, enantiomers and diastereomers, Projection formulae and geometrical isomerism, Reactions - Hofmann reaction and Riemer-Tiemann reaction, Diels-Alder reaction and Cannizaro reaction, Skraup synthesis.

Polymer Chemistry - Concept of polymerization – Types of polymerization, Chain growth polymerization – mechanisms of free radical and cationic polymerizations, Mechanisms of simple anionic polymerization and co-ordination anionic polymerization (complex forming mechanism), Step-growth polymerization ,Mechanism and examples.

Thermoplastic resins and Thermosetting resins- examples and applications, conducting polymers: Mechanism of conduction in polymers – Examples – and applications.

Review Of Chemical Spectroscopy - Review of electromagnetic spectrum, Quantization of energy, Born – Oppenheimer approximation, Frank Condon Principle Vibrational spectra (Infra-red) of diatomic molecules – Selection rules Determination of force constant Problems, Identification of functional groups using IR spectroscopy Electronic spectroscopy - Types of electronic transitions –calculation of chromophoric absorptions For Diene and ene-one chromophors Qualitative analysis by electronic spectroscopy, Lambert – Beer's law- Applications in Quantitative analysis and problems.

NMR spectroscopy: Basic principles, Concept of chemical shift. Concept of spin-spin splitting and examples, Applications of UV,I.R and ^{1}H NMR spectra in the determination of structures of Ethyl alcohol, Dimethyl ether, Acetic acid and Benzyl alcohol.

Photo Chemistry – Principles of photochemistry – Rates of intermolecular processes, Jablonski diagram – fluorescence, phosphorescene and Chemiluminescence, Types of Photochemical Organic reactions, Laws of photochemistry and quantum yields-problems, Photosensitized reactions.

Reading:

1. P. W. Atkins & Julio de Paula, Atkins Physical Chemistryl Chemistry, Oxford University Press York, 7th Edn, 2002.
2. Shashi Chawla, A Text Book of Engineering Chemistry, 3rd Edition, Dhanpat Rai & Co New Delhi, 2007.
3. S. Vairam, P. Kalyani & Suba Ramesh, Engineering Chemistry, Ist Edn, John Wiley & Sons, India, 2011.
4. Lee J.D., Concise Inorganic Chemistry, 7th Edn, Blackwel Science Publications Oxford, London, 2004.
5. Jerry March., Advanced Organic Chemistry, 6th Edn, John Wiley & Sons, New Jersy, 2007.
6. FehFuYen, Chemistry for Engineers, Imperial College Press, 2008.
7. Octave Levenspiel, Chemical Reaction Engineering, 2nd Edition, Wiley India, 2006.
8. Smith J.M., Chemical Engineering Kinetics, 3rd Edition, McGraw Hill, 1981.

EC101	BASIC ELECTRONICS ENGINEERING	ESC	3 – 0 – 0	3 Credits

Pre-requisites: None.

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

CO1	Characterize semiconductors, diodes, transistors and operational amplifiers
CO2	Design simple analog circuits
CO3	Design simple combinational and sequential logic circuits
CO4	Understand functions of digital multimeter, cathode ray oscilloscope and transducers in the measurement of physical variables
CO5	Understand fundamental principles of radio communication

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-
CO3	-	1	-	-	-	1	1	1
CO4	-	-	-	-	1	1	-	-
CO5	-	-	-	-	-	-	-	-

Detailed Syllabus:

Electronics Systems: Introduction to electronics, review of p-n junction operation, diode applications, Zener diode as regulator.

Transistor and applications: Introduction to transistors, BJT Characteristics, biasing and applications, simple RC coupled amplifier and frequency response. Cascaded amplifiers, FET and MOSFET characteristics and applications.

Feedback in Electronic Systems: open loop and closed loop systems, Negative and positive feedback merits and demerits, Principle of oscillators, LC and RC oscillators.

Integrated Circuits: Operational amplifiers, Applications: adder, subtractor, Integrator and Differentiators.

Digital Circuits: Number systems and logic gates, Combinational Logic circuits, Flip-Flops, counters and shift registers, data converters, Analog to Digital and Digital to Analog converters (ADC/DAC's).

Electronic Instrumentation: Measurement, Sensors, Laboratory measuring instruments: digital multi-meters and Cathode Ray Oscilloscopes (CRO's).

Principles of Communication: Need for Modulation, Modulation and Demodulation techniques.

Reading:

1. Neil Storey, “Electronics A Systems Approach”, 4/e - Pearson Education Publishing Company Pvt Ltd, 2011.
2. Salivahanan, N Suresh Kumar, “Electronic Devices and Circuits” 3/e, McGraw Hill Publications, 2013.
3. Bhargava N. N., D C Kulshreshtha and S C Gupta, “Basic Electronics & Linear Circuits”, Tata McGraw Hill, 2/e, 2013 .

EE101	BASIC ELECTRICAL ENGINEERING	ESC	3 – 0 – 0	3 Credits

Pre-requisites: None.

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

CO1	Analyze and solve electric and magnetic circuits
CO2	Identify the type of electrical machines for a given application
CO3	Recognize the ratings of different electrical apparatus
CO4	Identify meters for measuring electrical quantities

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	1	1	-	-	-	-	1	1
CO2	-	-	-	-	-	-	1	1
CO3	-	-	-	-	-	-	1	-
CO4	-	1	1	-	-	-	1	1

Detailed Syllabus:

DC Circuits: Kirchhoff's Voltage & Current laws, Superposition Theorem, Star – Delta Transformations.

AC Circuits: Complex representation of Impedance, Phasor diagrams, Power & Power Factor, Solution of Single Phase Series & Parallel Circuits. Solution of Three Phase circuits and Measurement of Power in Three Phase circuits.

Magnetic Circuits: Fundamentals and Solution of Magnetic Circuits, Concepts of Self and Mutual Inductances, Coefficient of Coupling.

Single Phase Transformers: Principle of Operation of a Single Phase Transformer, EMF equation, Phasor diagram, Equivalent Circuit, Determination of Equivalent Circuit Parameters, Regulation and Efficiency of a single phase transformer. Principle of operation of an Auto Transformer.

DC Machines: Principle of Operation, Classification, EMF and Torque equations, Characteristics of Generators and Motors, Speed Control Methods and Starting Techniques.

Three Phase Induction Motor: Principle of Rotating Magnetic Field, Principle of Operation of 3-φ I.M., Torque-Speed Characteristics of 3-φ I.M., Starting Methods and Applications of Three Phase Induction Motors.

Measuring Instruments: Moving Coil and Moving Iron Ammeters and Voltmeters, Dynamometer Type Wattmeter and Induction Type Energy Meter.

Reading:

1. Edward Hughes, Electrical Technology, 10th Edition, ELBS, 2010.
2. Vincent Del Toro, Electrical Engineering Fundamentals, 2nd Edition, PHI, 2003.
3. V.N. Mittle, Basic Electrical Engineering, TMH, 2000.

CE101	ENGINEERING MECHANICS	ESC	4 – 0 – 0	4 Credits

Pre-requisites: None.

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

CO1	Determine the resultant force and moment for a given system of forces
CO2	Analyze planar and spatial systems to determine the forces in members of trusses, frames and problems related to friction
CO3	Calculate the motion characteristics of a body subjected to a given force system
CO4	Determine the deformation of a shaft and understand the relationship between different material constants
CO5	Determine the centroid and second moment of area

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	-	-	2	-	-	-	1
CO2	3	-	-	2	-	-	-	1
CO3	3	-	-	2	-	-	-	-
CO4	3	-	1	2	-	-	-	-
CO5	3	-	-	2	-	-	-	-

Detailed syllabus:

Introduction - Specification of force vector, Formation of Force Vectors, Moment of Force – Cross product – Problems, Resultant of a general force system in space, Degrees of freedom - Equilibrium Equations, Kinematics – Kinetics – De' Alemberts principle, Degree of Constraints – Freebody diagrams.

Spatial Force systems - Concurrent force systems - Equilibrium equations – Problems, Problems (Vector approach) – Tension Coefficient method, Problems (Tension Coefficient method), Parallel force systems - problems, Center of Parallel force system – Problems.

Coplanar Force Systems - Introduction – Equilibrium equations – All systems, Problems on Coplanar Concurrent force system, Coplanar Parallel force system, Coplanar General force system – Point of action, Method of joints, Method of sections, Method of sections, Method of members, Friction – Coulombs laws of dry friction – Limiting friction, Problems on Wedge friction, Belt Friction-problems.

Mechanics of Deformable Bodies - Stress & Strain at a point- Normal and shear stresses, Axial deformations – Problems on prismatic shaft, tapered shaft and deformation due to self-weight,

Deformation of Stepped shaft due to axial loading, Poisson's Ratio – Bulk Modulus - Problems, change in dimensions and volume.

Centroid & Moment of Inertia - Centroid & M.I – Arial & Mass M.I – Radius of Gyration, Parallel axis– Perpendicular axis theorem – Simple Problems.

Dynamics of Particles - Rectilinear Motion – Kinematics Problems, Kinetics – Problems, Work & Energy – Impulse Moment, Direct Central Impact – coefficient of restitution, Curvilinear Motion – Projectile Motion, Work & Energy in Curvilinear motion.

Dynamics of Rigid Bodies - Rigid body rotation – Kinematics - Kinetics, Problems – Work & Energy in Rigid body rotation, Plane Motion – Kinematics, Problem – Instantaneous center of rotation.

Reading:

1. J.L.Meriam and L.G. Kraige, Engineering Mechanics, 7th Ed, John Wiley & Sons, 2012.
2. Timoshenko and Young, Engineering Mechanics, 3rd Ed, McGraw Hill Publishers, 2006.
3. Gere and Timoshenko, Mechanics of Materials, 2nd Ed, CBS Publishers, 2011.

CE102	ENVIRONMENTAL SCIENCE AND ENGINEERING	ESC	3 – 0 – 0	3 Credits

Pre-requisites: None.

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

CO1	Identify environmental problems arising due to engineering and technological activities and the science behind those problems.
CO2	Estimate the population - economic growth, energy requirement and demand.
CO3	Analyse material balance for different environmental systems.
CO4	Realize the importance of ecosystem and biodiversity for maintaining ecological balance.
CO5	Identify the major pollutants and abatement devices for environmental management and sustainable development

Correlation between the Course Outcomes(CO) and the Program Outcomes(PO)

Course outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1		1	1	1	1	2		1
CO2		2		3	1	3		1
CO3	1	2		2	2	2	1	1
CO4	1	2	1	2	2	2	2	1
CO5	1		2	3	2		1	1

Detailed Syllabus:

Nature and scope of Environmental Problems: Environment and society, environmental disturbances, role of technology, sustainable development, quantification of environmental issues.

Population and Economic growth: Economic growth and industrialization urbanization, Resource consumption, Renewable and nonrenewable resources, Energy requirement and development.

Global Atmospheric systems: Concept of climate change, green house effect, global energy balance, global warming, carbon cycle, Intergovernmental Panel for Climate Change (IPCC) emission scenarios, impact of climate change.

Mass balance and Environmental chemistry: Mass and Energy balance, Particle dispersion, oxygen demand, carbon emission, enthalpy in environmental systems, chemical equilibria.

Ecology and Biodiversity: Energy flow in ecosystem, food chain, nutrient cycles, eutrofication, value of biodiversity, biodiversity at global, national and local levels, threats for biodiversity, conservation of biodiversity

Water Pollution: water pollutants, effects of oxygen demanding waste on water, water quality in lakes, reservoirs and groundwater, contaminant transport, self cleaning capacity of streams and water bodies, water quality standards, principles of water and wastewater treatment.

Air Pollution: Overview of emissions, pollutant standard index, toxic air pollutants, vehicle emissions, indoor air quality, principles of air pollution control.

Solid and Hazardous Waste: Characteristics of Solid and Hazardous Waste, Collection and transfer system, recycling, composting, waste to energy conversion, landfills.

Environmental Management: Sustainable development, Environmental Impact Assessment (EIA), Environmental Ethics, Legal aspects.

Reading:

1. J.G. Henry and G.W. Heinke, Environmental Science and Engineering, Pearson Education, 2004
2. G.B. Masters, Introduction to Environmental Engineering and Science, Pearson Education, 2004.

ME101	BASIC MECHANICAL ENGINEERING	ESC	3 – 0 – 0	3 Credits

Pre-requisites: None.

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

CO1	Understand basics of thermodynamics and components of a thermal power plant
CO2	Identify engineering materials, their properties, manufacturing methods encountered in engineering practice
CO3	Understand basics of heat transfer, refrigeration and internal combustion engines
CO4	Understand mechanism of power transfer through belt, rope, chain and gear drives
CO5	Understand functions and operations of machine tools including milling, shaping, grinding and lathe machines

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	2	-	1	1	-	-	1	1
CO2	1	-	3	1	-	-	2	1
CO3	1	-	1	1	2	-	1	1
CO4	2	-	-	-	-	-	1	-
CO5	-	-	-	-	-	-	1	-

Introduction: Introduction to Thermodynamics - Concept of a System – Types of Systems, Thermodynamic Equilibrium, Properties, State, Process and Cycle, Zeroth Law, Energy Interactions - Heat and Work, Types of Work, Work interactions in a closed System for various processes

First and Second Laws of Thermodynamics: First Law: Cycle and Process, Specific Heats (c_p and c_v), Heat interactions in a Closed System for various processes, Limitations of First Law, Concept of Heat Engine (H.E.) and Reversed H.E. (Heat Pump and Refrigerator), Efficiency/COP, Second Law: Kelvin-Planck and Clausius Statements, Carnot Cycle, Carnot Efficiency, Statement of Clausius Inequality, Property of Entropy, T-S and P-V Diagrams

Thermal Power Plant: Thermal Power Plant Layout – Four Circuits, Rankine Cycle, Boilers: Fire Tube vs Water Tube; Babcock & Wilcox, Cochran Boilers, Steam Turbines:

Impulse vs Reaction Turbines, Compounding of Turbines: Pressure Compounding, Velocity Compounding, Pressure-Velocity Compounding, Condensers: Types – Jet & Surface Condensers, Cooling Towers

Manufacturing Processes: Engineering Materials: Classification, Properties of Materials, Manufacturing Processes: Metal Casting, Moulding, Patterns, Metal Working: Hot Working and Cold Working, Metal Forming: Extrusion, Forging, Rolling, Drawing

Internal Combustion Engines and Refrigeration: IC Engines: 2 - Stroke and 4 - Stroke Engines, S.I. Engine and C.I. Engine: Differences, P-V and T-S Diagrams

Refrigeration System and Refrigerants: Principle and working of standard vapor compression refrigeration system and Brief description of Refrigerants

Heat Transfer: Heat Transfer: Modes; Thermal Resistance Concept, Conduction: Composite Walls and Cylinders, Combined Conduction and Convection: Overall Heat Transfer Co-efficient, Simple Numerical Problems: Heat Transfer

Welding: Welding: Gas Welding and Arc Welding, Soldering, Brazing

Power Transmission: Transmission of Mechanical Power: Belt Drives – Simple Numerical Problems, Gear Drives – Simple Numerical Problems

Basics of Automotive Vehicle: Lay out of Automobile Transmission; Brakes – Types, Clutch, Differential

Machine Tools and Machining Processes: Machine Tools Machine Tools: Lathe Machine, Lathe Operations, Milling Machine-Types, Milling Operations, Shaper and Planer Machines: Differences, Quick-Return Motion Mechanism, Drilling Machine: Operations, Grinding Machine: Operations

Reading:

1. Mathur, M.L., Mehta, F.S., and Tiwari, R.P., Elements of Mechanical Engineering, Jain Brothers, New Delhi, 2011.
2. Roy, K.P., and Hazra Chowdary, S.K.., Elements of Mechanical Engineering, Media Promoters and Publishers Pvt. Ltd., 2002.
3. Rudramoorthy, R.., Thermal Engineering, Tata McGraw Hill Book Company, New Delhi, 2003.
4. Hazra Chowdary., S.K. and Bose, Workshop Technology, Vol. I and II, Media Promoters and Publishers Pvt. Ltd., 2002.

ME102	ENGINEERING GRAPHICS	ESC	2 – 0 – 3	4 Credits

Pre-requisites: None.

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

CO1	Draw Orthographic projections of Lines, Planes, and Solids
CO2	Construct Isometric Scale, Isometric Projections and Views
CO3	Draw Sections of various Solids including Cylinders, cones, prisms and pyramids
CO4	Draw projections of lines, planes, solids, isometric projections and sections of solids including Cylinders, cones, prisms and pyramids using AutoCAD

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	-	-	-	2	-	-	1	-
CO2	-	-	-	2	-	-	1	-
CO3	-	-	-	2	-	-	1	-
CO4	-	-	-	2	-	-	1	-

Detailed Syllabus:

Introduction: Overview of the course, Examination and Evaluation patterns.

Lines Lettering and Dimensioning: Types of lines, Lettering, Dimensioning, Geometrical Constructions, Polygons, Scales.

Orthographic projection of points: Principles of Orthographic projection, Projections of points.

Projections of Lines: Projections of a line parallel to one of the reference planes and inclined to the other, line inclined to both the reference planes, Traces

Projections of Planes: Projections of a plane perpendicular to one of the reference planes and inclined to the other, Oblique planes.

Projections of Solids: Projections of solids whose axis is parallel to one of the reference planes and inclined to the other, axis inclined to both the planes.

Section of Solids: Sectional planes, Sectional views - Prism, pyramid, cylinder and cone, true shape of the section.

Isometric views: Isometric axis, Isometric Planes, Isometric View, Isometric projection, Isometric views – simple objects.

Auto-CAD practice: Introduction to Auto-CAD, DRAW tools, MODIFY tools, TEXT, DIMENSION, PROPERTIES tool bar, Standard Tool bar, LAYERS

Reading:

1. N.D. Bhat and V.M. Panchal, Engineering Graphics, Charotar Publishers 2013
2. E. Finkelstein, “AutoCAD 2007 Bible”, Wiley Publishing Inc., 2007

CS101	PROBLEM SOLVING AND COMPUTER PROGRAMMING	ESC	4 – 0 – 0	4 Credits

Pre-requisites: None.

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

CO1	Develop algorithms for mathematical and scientific problems
CO2	Explore alternate algorithmic approaches to problem solving
CO3	Understand the components of computing systems
CO4	Choose data types and structures to solve mathematical and scientific problem
CO5	Develop modular programs using control structures
CO6	Write programs to solve real world problems using object oriented features

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	-	-	-	-	-	-	1	-
CO2	2	-	-	2	-	1	-	1
CO3	-	-	-	-	-	-	-	1
CO4	-	1	-	-	-	-	-	1
CO5	-	-	-	-	-	-	1	1
CO6	-	-	-	-	-	-	1	1

Detailed Syllabus:

Problem solving techniques – algorithms.

Introduction to computers - Basics of C++ - Number representation, Basic data types - int, float, double, char, bool, void.

Flow of Control - Conditional statements - If-else, Switch-case constructs, Loops - while, do-while, for.

Functions - user defined functions, library functions, parameter passing - call by value, call by reference, return values, Recursion.

Arrays - Single, Multi-Dimensional Arrays, initialization, accessing individual elements, passing arrays as parameters to functions.

Pointers and Dynamic Arrays - Multidimensional Dynamic Arrays, creation and deletion of single and multi-dimensional arrays.

C Strings, Standard String Class

I/O Streams, stream flags, stream manipulators, formatted I/O, binary I/O, Character I/O, File I/O - Opening, closing and editing files.

Structures and Classes - Declaration, member variables, member functions, access modifiers, inheritance, function overloading, overriding, redefinition, virtual functions, operator overloading, polymorphism - compile time and runtime binding.

Reading:

1. Walter Savitch, Problem Solving with C++, Sixth Edition, Pearson, 2007.
2. Cay Horstmann, Timothy Budd, Big C++, Wiley, Indian Edition, 2006.

PH102	PHYSICS LABORATORY	BSC	0 – 0 – 3	2 Credits

Pre-requisites: None.

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

CO1	Use CRO, signal generator, spectrometer, polarimeter and GM counter for making measurements
CO2	Test optical components using principles of interference and diffraction of light
CO3	Determine the selectivity parameters in electrical circuits
CO4	Determine the width of narrow slits, spacing between close rulings using lasers and appreciate the accuracy in measurements

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	-	1	1	-	-	-	-	-
CO2	-	1	1	-	-	-	-	-
CO3	-	1	1	-	-	-	-	-
CO4	-	1	-	-	-	-	-	-

Detailed Syllabus:

1. Determination of Wavelength of Sodium light using Newton's Rings.
2. Determination of Wavelength of He-Ne laser – Metal Scale.
3. Measurement of Width of a narrow slit using He- Ne Laser.
4. Determination of Specific rotation of Cane sugar by Laurent Half-shade Polarimeter.
5. Determination of capacitance by using R-C circuit.
6. Determination of resonating frequency and bandwidth by LCR circuit.
7. Measurement of half-life of radioactive source using GM Counter.
8. Diffraction grating by normal incidence method.

Reading:

1. Physics Laboratory Manual.

CY102	CHEMISTRY LABORATORY	BSC	0 – 0 – 3	2 Credits

Pre-requisites: None.

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

CO1	Synthesize polymers
CO2	Analyze ores and bleaching powder
CO3	Estimate the Hardness of water in terms of Calcium and Magnesium ions
CO4	Determine salt content using chromatographic techniques
CO5	Standardize solutions using titration, conductivity meter, pH-meter, potentiometer and colorimeter
CO6	Verify the Freundlich adsorption isotherm

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	-	-	1	-	-	-	-	-
CO2	-	-	2	-	-	-	-	-
CO3	-	-	2	-	-	-	-	-
CO4	-	-	2	-	-	-	-	-
CO5	-	-	1	-	-	-	-	-
CO6	-	-	2	1	-	-	-	-

Detailed Syllabus:

Cycle 1

1. Standardization of potassium permanganate.
2. Determination of MnO2 in Pyrolusite.
3. Determination of Iron in Haematite.
4. Determination of available Chlorine in bleaching powder and of Iodine in Iodized salt.
5. Determination of hardness of water and of calcium in milk powder.
6. Chemistry of blue printing.

7. Preparation of phenol formaldehyde resin.

Cycle 2

1. Conductometric titration of an Acid vs Base.
2. pH-metric titration of an Acid vs Base.
3. Potentiometric titration of Fe^{2+} against $K_2Cr_2O_7$.
4. Colorimetric titration of potassium permanganate.
5. Determination of rate of corrosion of mild steel in acidic environment in the absence and presence of an inhibitor.
6. Determination of salt content by Ion-exchange.
7. Separation of Ions by paper chromatography.
8. Verification of Freundlich adsorption isotherm.

Reading:

1. Valentin, W. G. "A Course of Qualitative Chemical Analysis" Read Books Design, 2010; ISBN: 1446022730, 9781446022733.
2. G. Svehla: Vogel's Qualitative Inorganic Analysis. J. Mendham, R. C. Denny, J. D. Barnes, M. J. K. Thomas: Vogel's Text Book of Quantitative Chemical Analysis.
3. G. N. Mukherjee: Semi-Micro Qualitative Inorganic Analysis (CU Publications) Vogel's Text Book of Practical Organic Chemistry (5th Edition).
4. N. G. Mukherjee: Selected Experiments in Physical Chemistry.

CS102	PROBLEM SOLVING AND COMPUTER PROGRAMMING LABORATORY	ESC	0 – 0 – 3	2 Credits

Pre-requisites: None.

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

CO1	Design and test programs to solve mathematical and scientific problems
CO2	Develop and test programs using control structures
CO3	Implement modular programs using functions
CO4	Develop programs using classes

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	-	-	-	-	-	-	1	-
CO2	-	-	-	-	-	-	2	-
CO3	-	-	-	-	-	-	1	-
CO4	-	-	-	-	-	-	1	-

Detailed Syllabus:

1. Programs on conditional control constructs.
2. Programs on loops (while, do-while, for).
3. Programs using user defined functions and library functions.
4. Programs on arrays, matrices (single and multi-dimensional arrays).
5. Programs using pointers (int pointers, char pointers).
6. Programs on structures.
7. Programs on classes and objects.
8. Programs on inheritance and polymorphism.

Reading:

1. Walter Savitch, Problem Solving with C++, 6th Edition, Pearson, 2008.
2. R.G. Dromey, How to solve it by Computer, Pearson, 2008.

ME103	WORKSHOP PRACTICE	ESC	0 – 0 – 3	2 Credits

Pre-requisites: None.

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

CO1	Study and practice on machine tools and their operations
CO2	Practice on manufacturing of components using workshop trades including fitting, carpentry, foundry and welding
CO3	Identify and apply suitable tools for machining processes including turning, facing, thread cutting and tapping
CO4	Apply basic electrical engineering knowledge for house wiring practice

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	-	1	-	-	1	-	1	-
CO2	-	1	-	-	1	-	1	-
CO3	-	1	-	-	1	-	1	-
CO4	-	1	-	-	1	-	1	-

Detailed Syllabus:

Fitting Trade: Preparation of T-Shape Work piece as per the given specifications, Preparation of U-Shape Work piece which contains: Filing, Sawing, Drilling, Grinding, and Practice marking operations.

Plumbing: Practice of Internal threading, external threading, pipe bending, and pipe fitting, Pipes with coupling for same diameter and with reducer for different diameters and Practice of T-fitting, Y-fitting, Gate valves fitting.

Machine shop: Study of machine tools in particular Lathe machine (different parts, different operations, study of cutting tools), Demonstration of different operations on Lathe machine, Practice of Facing, Plane Turning, step turning, taper turning, knurling and parting and Study of Quick return mechanism of Shaper.

Power Tools: Study of different hand operated power tools, uses and their demonstration and Practice of all available Bosch Power tools.

Carpentry: Study of Carpentry Tools, Equipment and different joints, Practice of Cross Half lap joint, Half lap Dovetail joint and Mortise Tenon Joint

House Wiring: Introduction to House wiring, different types of cables. Types of power supply, types of motors, Starters, distribution of power supply, types of bulbs, parts of tube light, Electrical wiring symbols, Stair case wiring: Demo and Practice (2 switches with one lamp control) and Godown wiring

Foundry Trade: Introduction to foundry, Patterns, pattern allowances, ingredients of moulding sand and melting furnaces. Foundry tools and their purposes, Demo of mould preparation and Practice – Preparation of mould by using split pattern.

Welding: Introduction, Study of Tools and welding Equipment (Gas and Arc welding), Selection of welding electrode and current, Bead practice and Practice of Butt Joint, Lap Joint.

Reading:

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

MA151	MATHEMATICS – II	BSC	4 – 0 – 0	4 Credits

Prerequisites: Mathematics – I.

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

CO1	Solve linear differential equations using Laplace transforms
CO2	Evaluate multiple integrals and improper integrals
CO3	Convert line integrals to area integrals
CO4	Convert surface integrals to volume integrals
CO5	Determine potential functions for irrotational force fields

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	2	-	-	3	-	-	-	2
CO2	2	2	-	2	-	-	-	1
CO3	2	2	-	2	-	-	-	1
CO4	2	2	-	2	-	-	-	1
CO5	2	1	-	2	-	-	-	1

Detailed Syllabus:

Laplace Transformation: Laplace transform - Inverse Laplace transform - properties of Laplace transforms - Laplace transforms of unit step function, impulse function and periodic function - convolution theorem - Solution of ordinary differential equations with constant coefficients and system of linear differential equations with constant coefficients using Laplace transform.

Integral Calculus: Fundamental theorem of integral calculus and mean value theorems; Evaluation of plane areas, volume and surface area of a solid of revolution and lengths. Convergence of Improper integrals – Beta and Gamma integrals – Elementary properties – Differentiation under integral sign. Double and triple integrals – computation of surface areas and volumes – change of variables in double and triple integrals.

Vector Calculus : Scalar and Vector fields; Vector Differentiation; Level surfaces - directional derivative - Gradient of scalar field; Divergence and Curl of a vector field - Laplacian - Line and surface integrals; Green's theorem in plane; Gauss Divergence theorem; Stokes' theorem.

Reading:

1. R.K.Jain and S.R.K.Iyengar, Advanced Engineering Mathematics, Narosa Pub. House, 2008.
2. Erwyn Kreyszig, Advanced Engineering Mathematics, John Wiley and Sons, 8th Edition, 2008.
3. B.S.Grewal, Higher Engineering Mathematics, Khanna Publications, 2009.

MA235	MATHEMATICAL METHODS	BSC	4 – 0 – 0	4 Credits

Prerequisites: Mathematics - I and Mathematics – II.

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

CO1	Determine Fourier series expansion of a given function
CO2	Evaluate improper integrals involving trigonometric functions
CO3	Solve finite difference equations by using Z transforms
CO4	Solve PDEs by variables separable method
CO5	Analyze null hypothesis for large and small samples
CO6	Solve initial value problems

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	1	-	-	1	-	-	-	1
CO2	1	-	-	1	-	-	-	1
CO3	1	-	-	2	-	-	-	1
CO4	1	-	-	2	-	-	-	1
CO5	-	-	-	-	-	2	-	1
CO6	1	-	-	1	-	1	-	1

Detailed Syllabus:

Fourier series: Expansion of a function in Fourier series for a given range - Half range sine and cosine expansions.

Fourier Transforms: Fourier transformation and inverse transforms - sine, cosine transformations and inverse transforms - simple illustrations.

Z-transforms: Z-transforms – Properties – Initial and final value theorems – Inverse transform - convolution theorem - Difference equations – solution of difference equations using z-transforms.

Partial Differential Equations: PDE types, Solution of Heat equation-method of separation of variables.

Complex Variables: Analytic function - Cauchy Riemann equations, Bilinear transformations, Conformal mapping – applications – combination of flow pattern.

Probability and Statistics: Probability laws – Addition and Multiplication theorems on probability - Baye's theorem –Expectation, Moments and Moment generating function of Discrete and

continuous distributions, Binomial, Poisson and Normal distributions, Testing of Hypothesis - Z-test for single mean and difference of means - t-test for single mean and difference of means, F-test for comparison of variances,. Chi-square test for goodness of fit. – Correlation, regression.

Numerical Analysis: Numerical solution of algebraic and transcendental equations by Regula-Falsi method Newton-Rapson's method - Newton's Forward, backward differences - Lagrange interpolation - Numerical Integration with Trapezoidal rule, Simpson's 1/3 rule, Simpson's 3/8 rule - solving first order differential equations -Euler's method, modified Euler's method, Runge-Kutta method of 2^{nd} & 4^{th} order.

Reading:

1. R.K.Jain and S.R.K.Iyengar, Advanced Engineering Mathematics, Narosa Publ., 2008.
2. B.S.Grewal, Higher Engineering Mathematics, Khannna Publishers.

CE201	STRENGTH OF MATERIALS	PCC	4 – 0 – 0	4 Credits

Prerequisites: Physics, Mathematics II and Engineering Mechanics.

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

CO1	Analyse the statically determinate and indeterminate problems
CO2	Determine the stresses and strains in the members subjected to axial, bending and torsional loads
CO3	Evaluate the slope and deflection of beams subjected to loads
CO4	Determine the principal stresses and strains in structural members

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	-	-	2	-	-	-	3
CO2	3	-	-	2	-	-	-	3
CO3	3	-	-	2	-	-	-	3
CO4	3	-	-	2	-	-	-	3

Detailed Syllabus:

Stress And Strain: Concept of Statical determinacy and indeterminacy- Determinate and Indeterminate problems in Tension and Compression - Thermal Stresses.

Elastic Constants and Impact Loading: Stress-strain diagrams for brittle and ductile materials - working stress - Strain energy in tension and compression - Impact loading - pure shear - Modulus of rigidity and Bulk modulus - Relation between E, G and K.

Shear Force And Bending Moment: Types of supports - Types of determinate beams - Simply supported, Cantilever, Overhanging and compound beams with articulations -Shear Force and Bending Moment diagrams - Principles of Superposition.

Thin Cylinders: Thin Cylinders under internal fluid pressure – Riveted Joint Connection - Wire wound thin cylinders.

Riveted Joints: Types of failures of riveted joints - Lap and Butt joints - Efficiency of the joint.

Theory Of Simple Bending: Assumptions - Theory of Simple Bending - Bending stresses in beams - Discussion of efficiency of various shapes of cross sections - Flitched beams.

Shear Stress Distribution: Flexural shear stress distribution in various shapes of cross section of beams.

Torsion Of Circular Shafts: Theory of Pure Torsion in Solid and Hollow circular shafts - Torsional Shear Stresses and angle of twist - transmission of Power.

Reading:

1. Timoshenko and Gere, Mechanics of Materials, CBS Publishers, New Delhi, 1996.
2. S.B.Junarkar and H.J.Shah, Mechanics of Structures, Charotar Publishers, Anand, 1998.
3. Beer and Johnston, Mechanics of Materials, McGraw Hill International Edition, 1995.
4. E.P.Popov, Engineering Mechanics of Solids, Prentice Hall of India Pvt. Ltd., 1998.

CE202	FLUID MECHANICS - I	PCC	4 – 0 – 0	4 Credits

Prerequisites: Engineering Mechanics, Mathematics II and Physics.

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

CO1	Apply conservation laws to derive governing equations of fluid flows
CO2	Compute hydrostatic and hydrodynamic forces
CO3	Analyze and design simple pipe systems
CO4	Apply principles of dimensional analysis to design experiments

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	-	-	-	-	2	-	1
CO2	3	-	-	3	-	-	-	-
CO3	3	-	-	3	-	-	-	-
CO4	2	2	-	2	-	-	-	2

Detailed Syllabus:

Introduction: Purpose of study of fluid mechanics for design and operation of engineering systems in the fields of Mechanical Engineering, Aeronautical Engineering, Metallurgical Engineering, Civil Engineering, Biomedical Engineering, Chemical Engineering, Fundamental difference between a solid and a fluid, constituent relationships for solids and fluids, conservation principles applied in fluid mechanics.

Properties of fluids, concept of continuum, viscosity, compressibility, ideal and real fluids, surface tension, cavitations.

Stress at a point, pressure, Pascal's law, Variation of pressure with elevation in compressible and incompressible fluids, hydrostatic law, Pressure measurement, piezometers and manometers Hydrostatic forces exerted on submerged surfaces.

Description of fluid flow: with reference to translation, rotation and deformation, concept of continuum, control mass & control volume approach, Reynolds transport theorem. Steady flow and uniform flow.

Velocity field, one & two-dimensional flow analysis, circulation and vorticity, stream function and velocity potential function, potential flow, standard flow patterns, combination of flow patterns, flownet.

Forces exerted in a fluid flow, derivation of Continuity equation and Euler's equation.

Bernoulli's equation and its applications.

Momentum equation and its applications.

Dimensional Analysis as a tool in design of experiments, identification of non-dimensional numbers and their significance, dimensional analysis methods.

Measurement of flow in pipes and open channels.

Laminar flow and its characteristics, Reynolds experiment.

Laminar flow between parallel plates.

Laminar flow through pipes, Hazen-Poiseuille equation.

Head loss in flow through pipes, Darcy Weisbach equation, major and minor losses.

Turbulence, Reynolds turbulent stresses, Prandtl's mixing length theory.

Velocity distribution in turbulent flow.

Flow through pipes and pipe networks, equivalent pipe.

Reading:

1. F M White, Fluid Mechanics, Tata McGraw Hill Publication 2011.
2. Robert W. Fox, Philip J. Pritchard, Alan T. McDonald, Introduction to Fluid Mechanics, Student Edition Seventh, Wiley India Edition, 2011.
3. Shames, Mechanics of Fluids, McGraw Hill Book Co., New Delhi, 1988.
4. Streeter V.L., Benjamin Wylie, Fluid Mechanics, McGraw Hill Book Co., New Delhi, 1999.

CE203	SURVEYING	PCC	4 – 0 – 0	4 Credits

Prerequisites: None.

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

CO1	Calculate angles, distances and levels
CO2	Identify data collection methods and prepare field notes
CO3	Understand the working principles of survey instruments
CO4	Estimate measurement errors and apply corrections
CO5	Interpret survey data and compute areas and volumes

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	-	3	-	1	-	-	-	-
CO2	-	3	-	-	1	-	-	-
CO3	-	3	-	-	1	-	-	-
CO4	-	3	-	-	1	-	-	-
CO5	-	-	-	-	-	-	3	1

Detailed Syllabus:

Introduction: Surveying objectives, plane surveying principles and classification, scales, linear measurements, instruments for surveying, preparation of map and plan.

Chain surveying: Measurement of distance, chain surveying principles, selection of stations, offsets, locating building corners, field book, chain surveying instruments, conventional signs.

Compass surveying: Measurement of directions and angles, types of compass, meridians and bearings, local attraction, magnetic declination, traversing with a chain and compass, plotting of traverse, adjustment of closing error.

Plane table surveying: Principle and instruments used in plane table surveying, working operations, methods of plane table surveying.

Levelling and contouring: Description of a point (position) on the earth's surface, instruments for leveling, principle and classification of leveling, bench marks, leveling staff, readings and booking of levels, field work in leveling, longitudinal section and cross section, plotting the profile, height (level) computations, contours, characteristics of contours, contours of natural features, methods of contouring, interpolation, contour gradient, contour maps.

Areas and volumes: Computation of areas from plans, calculation of areas of a closed traverse, instruments for map areas computation, measurements from cross section, calculation of volumes from spot levels, earth work calculations, practical problems.

Theodolite survey and traversing: Theodolite component parts, classification, theodolite observations, principle of theodolite survey and traversing, field work, traverse computations, practical problems.

Tacheometric surveying: Instruments, principle of tacheometry, methods of tacheometry, tacheometric tables, reduction diagram, tacheometry as applied to subtense measurement, field work for tacheometric surveying, errors.

Trigonometrical surveying: Base of the object accessible, base of an inclined object accessible, reduced level of the elevated points with inaccessible bases, instrument axes at different levels.

Curve settting: Types of curves, elements of a curve, setting out a simple curve, setting out a compound curve, checks on field work, reverse curve, transition curves, super elevation, deflection angles, transition curves, characteristics of transition curves, method of setting out a compound curve, types of vertical curves, setting out vertical curves, sight distance.

Triangulation: Principle of triangulation, purpose and classification of triangulation surveys, layout of triangulation, field work, triangulation stations, triangulation computations, EDM instruments, Total Station, Global Positioning System.

Reading:

1. B.C. Punmia, Ashok Kumar Jain, Ashok Kr. Jain, Arun Kr. Jain., Surveying I & II, Laxmi Publications, 2005.
2. Chandra A. M., Higher Surveying, New Age International Publishers, 2007.
3. Chandra A. M., Plane Surveying, New Age International Publ., 2007.
4. Charles D Ghilani, Paul R Wolf., Elementary Surveying, Prentice Hall, 2012.

CE204	CIVIL ENGINEERING MATERIALS	PCC	3 – 0 – 0	3 Credits

Prerequisites: None.

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

CO1	Identify and characterize building materials
CO2	Understand the manufacturing process of bricks and cement
CO3	Identify the methods for preservation of timber and metals
CO4	Understand the use of non-conventional Civil Engineering materials

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	2	1	-	2	-	-	-	-
CO2	2	2	-	3	-	-	-	-
CO3	3	1	-	2	-	-	-	-
CO4	2	2	-	3	-	-	-	-

Detailed Syllabus:

Building stones: Classification of stones- Characteristics of good building stones, important types of building atones, their properties and stones and uses.

Brick & other clay products: Composition of brick-earth, manufacturing process of bricks, characteristics of good building bricks, classification and testing of bricks, special types of bricks and their uses. Types of tiles and their use in buildings. Terracotta, stoneware.

Lime & cement: IS classification of lime and uses, flow diagram of manufacturing process of cements, chemical composition of cement, IS specifications and tests on Portland cement, different types of cements and their uses.

Mortar & concrete: Preparation of cement mortar and concrete, proportion of mortars and concrete for different types of works, properties of concrete in plastic and hardened stages, factors affecting strength of concrete, types of concrete and their specific use.

Timber & wood based products: Classification of timber trees, cross section of exogenous tree, hard wood and soft wood, seasoning of timber, important types of timber and their uses, ply wood and its uses.

Steel & aluminium: Types of steel-mild steel, high carbon steel, high strength steel- properties and uses, commercial forms of steel and their uses.

Introduction to some new materials: Ferro cement, super plasticizers, FAL-G brick, fly ash, plastics, paints, and geotextiles.

Reading:

1. Civil engineering Materials and Construction Practices by R.K. GUPTA, Jain Brothers, (New Delhi).
2. Civil engineering Materials by S.C. Rangwala, Charotar Publishing House (1992).
3. Civil engineering Materials by Tech. Teachers Training Institute, Tata Mc Graw Hill (1992).

CE205	MATERIAL TESTING LABORATORY	PCC	0 – 0 – 3	2 Credits

Prerequisites: Strength of Materials.

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

CO1	Conduct tension test on steel, aluminium, copper and brass
CO2	Conduct compression tests on spring, wood and concrete
CO3	Conduct flexural and torsion test to determine elastic constants
CO4	Determine hardness of metals

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8

CO1	3	1	2	-	-	-	-	2
CO2	3	1	2	-	-	-	-	2
CO3	3	1	2	-	-	-	-	2
CO4	3	1	2	-	-	-	-	2

Detailed Syllabus:

To study the stress -strain characteristics of (a) Mild Steel and (b) Tor steel by conducting tension test on U.T.M.

To study the stress - strain characteristics of (a) Copper and (b) Aluminium by conducting tension test on Hounsfield Tensometer.

To find the Compressive strength of wood and punching shear strength of G.I. sheet by conducting relevent tests on Hounsfield Tensometer.

To find the Brinnell's and Vicker's hardness numbers of (a) Steel (b) Brass (c) Aluminium (d) Copper by conducting hardness test.

To determine the Modulus of rigidity by conducting Torsion test on (a) Solid shafts (b) Hollow shaft.

To find the Modulus of rigidity of the material of a spring by conducting Compression test.

To determine the Young's modulus of the material by conducting deflection test on a simply supported beam.

To determine the Modulus of elasticity of the material by conducting deflection test on a Propped Cantilever beam.

To determine the Modulus of elasticity of the material by conducting deflection test on a continuous beam.

Ductility test for steel.

Shear test on Mild Steel rods.

Reading:

1. Timoshenko and Gere, Mechanics of Materials, CBS Publishers, New Delhi, 1996.

CE206	FLUID MECHANICS LABORATORY	PCC	0 – 0 – 3	2 Credits

Prerequisites: None.

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

CO1	Apply dimensional analysis for design of experimental procedures
CO2	Calibrate flow measuring devices used in pipes, channels and tanks
CO3	Determine fluid and flow properties
CO4	Characterize laminar and turbulent flows

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	-	3	-	-	-	-	-	2
CO2	2	3	-	2	-	-	-	-
CO3	3	3	2	-	-	-	-	-
CO4	-	3	-	2	-	-	-	2

Detailed Syllabus:

1. Calibration of Venturi metre, Orifice metre (discharge measuring device in pipes).
2. Calibration of Orifice and mouthpiece (discharge measuring device in Tanks).
3. Calibration of Triangular – Notch and rectangular notch (discharge measuring device in Channels).
4. Measurement of Viscosity of water, SAE – 10 Oil by Hazen- Poiseuille method and that of gleserene by Stoke's method.
5. Determination of Darcy Friction Factor, relative roughness for laminar and turbulent flows.
6. Application of momentum equation for determination of coefficient of impact of jets on flat and curved blades and Pelton bucket.

Reading:

1. K.L.Kumar. "Engineering Fluid Mechanics" Experiments, Eurasia Publishing House, 1997.
2. Jagdish Lal, Hydraulic Machines, Metropolitan Book Co, Delhi, 1995.

CE207	SURVEYING LABORATORY	PCC	0 – 0 – 4	3 Credits

Prerequisites: Surveying.

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

CO1	Conduct survey and collect field data
CO2	Prepare field notes from survey data
CO3	Interpret survey data and compute areas and volumes

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	2	3	-	1	1	-	-	-
CO2	2	1	-	1	1	-	-	-
CO3	3	3	-	2	1	-	-	-

Detailed Syllabus:

1. Introduction & list of equipments.
2. Survey of an area by chain survey (closed traverse) & plotting.
3. Compass Traversing.
4. Theodololite Traversing.
5. Radiation method, intersection methods by plane table survey.
6. Traversing by plane table survey.
7. Fly leveling (differential leveling).
8. Longitudinal and Cross Sectioning.
9. Grid Contouring.
10. Indirect Contouring.
11. Total Station Surveying.

Reading:

1. B.C. Punmia, Ashok Kumar Jain, Ashok Kr. Jain, Arun Kr. Jain., Surveying I & II, Laxmi Publications, 2005.
2. Chandra A. M., Higher Surveying, New Age International Publishers, 2007.
3. Chandra A. M., Plane Surveying, New Age International Publ., 2007.
4. Charles D Ghilani, Paul R Wolf., Elementary Surveying, Prentice Hall, 2012.

CE251	MECHANICS OF MATERIALS	PCC	3 – 0 – 0	3 Credits

Prerequisites: Strength of Materials.

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

CO1	Determine slope and deflection of beams
CO2	Analyze columns and struts
CO3	Understand the concept of failure theories
CO4	Analyze and design springs and thick cylinders

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8

CO1	3	-	-	2	-	-	-	3
CO2	3	-	-	2	-	-	-	3
CO3	3	-	-	2	-	-	-	3
CO4	3	-	-	2	-	-	-	3

Detailed Syllabus:

Deflection Of Beams: Double Integration method. Conjugate Beam method - Calculation of Slope and deflections of Simply Supported Beams, Cantilever Beams and Overhanging Beams.

Strain Energy in Flexure and Castigliano's Theorem: Strain Energy of Beams in bending - Deflection of beams from Strain Energy. Castigliano's Theorems and Unit load method - application to statically determinate beams for determining slopes and deflections.

Columns and Struts: Direct and Bending stresses - Kernel of a section - Euler's critical load for columns with ordinary end conditions - Slenderness ratio and effective length of a column - Rankine's Formula - IS Code formula - Critical load of eccentrically loaded columns.

Principal Stresses and Strains at a Point: Analysis of Biaxial state of stress at a point - Principal Planes - Principal stresses and strains - Mohr's Circle and its application to different cases - combined bending and torsion with or without end thrust - Equivalent Bending Moment and Equivalent Twisting Moment.

Springs: Types and classification of springs – Analysis of Close and open coiled helical springs subjected to axial load and axial twist – Strain energy of springs.

Shear Centre: Concept of Shear Centre – Shear Centre of various cross sections – Shear flow – Shear lag.

Failure Theories: (1) Maximum Principal Stress Theory (2) Maximum Principal Strain Theory (3) Maximum Shear Stress Theory (4) Total Energy Theory (5)Distortion energy theory, Application to shafts under the action of combined bending and torque.

Reading:

1. Beer and Johnston, Mechanics of Materials, McGraw Hill International Edition, 1995.
2. Timoshenko and Gere, Mechanics of Materials, CBS Publishers, New Delhi, 1996.
3. S.B.Junarkar, Mechanics of Structures, Charotar Publishers, Anand, 1998.

CE252	FLUID MECHANICS – II	PCC	3 – 0 – 0	3 Credits

Prerequisites: Mathematical Methods and Fluid Mechanics – I.

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

CO1	Compute drag and lift coefficients
CO2	Design channels
CO3	Compute flow profiles in channel transitions and analyze hydraulic transients
CO4	Design the working proportions of hydraulic machines
CO5	Analyze compressible flows of liquids and gases

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	2	-	3	-	-	-	2
CO2	2	-	-	3	-	-	1	2
CO3	3	-	-	3	2	2	2	3
CO4	1	-	-	3	2	-	1	2
CO5	3	-	-	1	-	-	2	2

Detailed Syllabus:

Boundary Layer Theory: Concepts of boundary layer flows, Laminar and turbulent boundary layers, Integral momentum equation for boundary layer flows, Boundary layer separation and control, Drag and lift.

Uniform Flow in Open Channels: Specific energy, Critical flow, Channel transitions, Uniform flow formulae, best hydraulic sections.

Steady Gradually Varied Flow: Non uniform flow in open channels, gradually varied flow equation, Type of GVF profiles, Computation of GVF profiles.

Steady Rapidly Varied Flow: Hydraulic jump in a horizontal rectangular channel, Specific force, Computation of energy loss.

Unsteady Flow: Celerity of a gravity wave, Monoclonal rising wave, Positive and negative surges, St. Venant's equations, Method of characteristics, Hydraulic routing.

Hydraulic Similitude: Review of dimensional analysis, Similarity laws, and Model studies.

Hydraulic Machinery: Classification of hydraulic machines, Euler's equation of turbo machines, one dimensional flow analysis and velocity triangles, Design of Pelton turbine, Design of Francis turbine, Design of centrifugal pump, Design of a Kaplan turbine/ axial flow pump, Selection of hydraulic machines.

Compressible Flows: Celerity of an elasticity wave, Area velocity relationships, Flow through nozzles, Constant area flow, Normal shocks, Water Hammer.

Reading:

1. Chow V.T. Open Channel Hydraulics, Blackburn Press , 2009.
2. Franck M White, Fluid Mechanics, Tata McGraw Hill Publications 2011.
3. Robert W. Fox Ogukuo H. Orutcgardm Alan T. Mc Donald, Introduction to Fluid Mechanics, Student Edition 7th Wiley India Edition, 2011.
4. Subramnaya, K., Flow In Open Channel, Tata McGraw Hill Publications, New Delhi, 2008.

CE253	DESIGN OF STEEL STRUCTURES	PCC	4 – 0 – 0	4 Credits

Prerequisites: Mathematical Methods and Mechanics of Materials.

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

CO1	Design tension and compression members
CO2	Design beams and beam columns
CO3	Design bolt and weld connections
CO4	Design built up members and column base

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	1	-	3	-	-	-	1
CO2	3	1	-	3	-	-	-	1
CO3	3	1	-	3	-	-	-	1
CO4	3	1	-	3	-	-	-	1

Detailed Syllabus:

Introduction: General- Types of Steel – Mechanical behaviour of steel – Measures of Yielding – Measures of Ductility – Types of Structures – Structural Steel Sections.

Methods of Structural design: Introduction-Design Philosophies-Working Stress method-Ultimate Strength method-Load and Resistant factor- Limit State Method-Partial safety factor-Load-Load combinations-Classification of Cross sections- General aspects in the design.

Design of Steel fasteners: Types of fasteners – Riveted connections- Bolted connections-Assumptions- Failure of bolted joints – Strength of bolted joints – Design examples – Design of Welded connections – Butt weld- fillet weld – Design examples.

Design of Tension Members: General – Modes of Failure of Tension member- Analysis of Tension members- Example - Design steps – Design examples – Lug angles – Design.

Design of Compression Members: General – Strength of Compression members- Design Compressive strength- Example on analysis of Compression members – Design of Angle struts – Design Examples- Built up Columns- Design of Lacing – Design of Battens- Design Examples-Design of Roof members.

Design of Beams: General- Lateral Stability of Beams- Bending Strength of Beams – Plastic Section Modulus - Design Examples.

Design of Beam Columns: Behaviour of members under combined loading – Modes of Failures – Design Examples.

Design of Column Splices and Column Base: Design of Column Splice-Design Examples- Design of Column Base- Slab Base- Gusseted Base- Design Examples.

Design of Eccentric Connections: Design of Brackets- Type-1 and Type 2 – Moment Resistant connections - Design Examples.

Design of Plate Girder: General- Components of Plate Girder- Optimum depth – Bending Strength – Shear Strength – Shear Buckling- Simple Post critical method- Tension Field method- Stiffeners-Bearing- Transverse stiffeners - Design Examples.

Reading:

1. Design of Steel Structures – Duggal.
2. Design of Steel structures – Bhavikatti S S.
3. IS-800-2007.
4. Design of Steel Structures - Arya & Azmani.

CE254	BUILDING PLANNING AND CONSTRUCTION	PCC	3 – 0 – 0	3 Credits

Prerequisites: Civil Engineering Materials.

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

CO1	Identify the factors to be considered in planning and construction of buildings.
CO2	Understand the construction practices and techniques
CO3	Plan a building following the bye-laws
CO4	Understand the techniques of damp proofing and fire resistance

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	2	2	-	1	-	-	-	-
CO2	3	3	-	3	-	-	-	-
CO3	2	1	-	3	-	-	-	-
CO4	1	2	-	3	-	-	-	-

Detailed Syllabus:

Functional Planning of buildings: General aspects to consider for planning, bye-laws and regulations, Selection of site for building construction, Principles of planning, Orientation of building and its different elements, Components of building.

Masonry: Definitions of terms used in masonry, Materials used, Stone masonry, Brick masonry, Different bonds used for brick masonry, Composite masonry.

Floors and Roofs: Components of a floor, materials used for floor construction, Different types of flooring, Ground floor and upper floors, Types of roofs, Basic roofing elements and Roof coverings.

Doors and Windows: Location of roofs and windows, Definition of technical terms, Size of doors and windows, Door frames, Types of doors and windows, Ventilators, Fixtures and fastenings.

Damp proofing, Fire protection and Thermal insulation: Causes and effect of dampness on buildings, Materials and methods used for damp proofing, Fire hazards, Grading of buildings according to fire resistance, Fire resisting properties of common building materials, Fire resistant construction, General methods of thermal insulation and thermal insulating materials.

Reading:

1. Varghese P. C. Building construction, PHI Learning Pvt. Ltd., 2008.
2. Punmia B. C., Jain A. J. and Jain A. J. Building construction, Laxmi Publications, 2005.
3. Arora S. P., and Bindra S. P. The text book of building construction, Dhanpat Rai Publications, 2010.
4. Design of Steel Structures - Arya & Azmani.

CE255	CONCRETE TECHNOLOGY	PCC	3 – 0 – 0	3 Credits

Prerequisites: Civil Engineering Materials.

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

CO1	Identify Quality Control tests on concrete making materials
CO2	Understand the behavior of fresh and hardened concrete
CO3	Design concrete mixes as per IS and ACI codes
CO4	Understand the durability requirements of concrete
CO5	Understand the need for special concretes

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	-	2	3	2	-	-	-	2
CO2	-	2	3	2	-	-	-	2
CO3	-	2	3	2	-	-	-	2
CO4	-	2	3	2	-	-	-	2
CO5	-	1	-	1	-	-	-	2

Detailed Syllabus:

Concrete Making Materials: Cement, Fine Aggregate, Coarse aggregate, Water, Chemical & Mineral admixtures.

Hydration of Cement: Bogue's compounds, Hydration, Gel formation, Types of cement, pore & capillary water.

Quality tests on cement: Different test on cement as per Indian standards

Aggregates: Tests on aggregates as per Indian standards, Bulking of sand, Sieve analysis – Grading.

Fresh concrete: Properties of fresh concrete- Workability – different tests of workability- Factors influencing workability compaction, finishing, curing.

Hardened concrete: Tests on hardened concrete as per IS codes – Relationship between different strengths – factors influencing strength, NDT techniques.

Durability: Factors influencing durability – Chemical effects on concrete- Carbonation, Sulphate attack, Chloride attack.

Concrete Mix design: Different methods of mix design – factors affecting mix design – exercises.

Special concrete: Heavy density concrete, underwater concrete, self-compacting concrete, light weight concrete etc.

Reading:

1. Properties of Concrete – AM Nevelli – 5th Ed, Prentice Hall Publishers, 2012.
2. Concrete Technology – M. S. Shetty – S Chand Co., Publishers – 2006.
3. Concrete Technology – M. L. Gambhir – Tata Mc Graw Hill Publishers – 2012.

CE256	HYDRAULIC ENGINEERING LABORATORY	PCC	0 – 0 – 3	2 Credits

Prerequisites: Fluid Mechanics Laboratory.

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

CO1	Compute drag coefficients
CO2	Test the performance of pumps and turbines
CO3	Determine Manning's and Chezy's coefficients for smooth and rough channels
CO4	Determine Energy loss in Hydraulic jump and Calibrate standing wave flume

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	-	1	-	-	-	-
CO2	-	3	-	-	1	-	-	-
CO3	-	3	-	1	-	-	-	-
CO4	-	3	-	1	-	-	-	-

Detailed Syllabus:

1. Determination of Manning's and Chezy's coefficients for smooth and rough channels by gradually varied flow method.
2. Determination of Energy loss in Hydraulic jump.
3. Calibration of standing wave flume.
4. Determination Velocity distributions in open channels.
5. Rainfall-runoff model by basic hydrology system.
6. Computation of pressure drag coefficient for flow past a cylinder in a subsonic wind tunnel.
7. Performance Characteristics of single stage centrifugal pump, multi stage centrifugal pump,
8. Submersible pumps, and varying speed centrifugal pump.
9. Performance Characteristics of Pelton turbine, Francis turbine, and Kaplan turbine.

Reading:

1. K.L.Kumar. "Engineering Fluid Mechanics" Experiments, Eurasia Publishing House, 1997.
2. Jagdish Lal, Hydraulic Machines, Metropolitan Book Co, Delhi, 1995.

CE257	BUILDING DRAWING	PCC	0 – 0 – 3	2 Credits

Prerequisites: Engineering Graphics.

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

CO1	Draw the plan, section and elevation of a building
CO2	Create, analyze and produce 2D drawings of buildings in AUTO CAD environment
CO3	Detailing building plans in CAD environment

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	-	3	-	-	-	-	-	-
CO2	-	3	-	-	-	-	-	-
CO3	-	3	-	-	-	-	-	-

Detailed Syllabus:

1. Getting started with AutoCAD.
2. Understanding the basic commands.
3. Executing Electric drawings.
4. Executing Mechanical drawings.
5. Drawing a civil engineering structures with design notations.
6. Drawing various plans and elevations.
7. Executing a spiral stair case in 3D.

Reading:

1. AutoCAD Manual.

CE258	CONCRETE LABORATORY	PCC	0 – 0 – 3	2 Credits

Prerequisites: Civil Engineering Materials and Concrete Technology.

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

CO1	Conduct Quality Control tests on concrete making materials
CO2	Conduct Quality Control tests on fresh & hardened concrete
CO3	Design and test concrete mix
CO4	Conduct Non-destructive tests on concrete

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	1	2	3	-	2	-	-	1
CO2	1	2	3	-	2	-	-	1
CO3	1	2	-	-	-	-	-	1
CO4	1	2	-	-	-	-	-	1

Detailed Syllabus:

1. Determination of Fineness and Specific Gravity of cement.
2. Determination of consistency of standard Cement Paste.
3. Determination of initial and Final Setting times of Cement.
4. Determination of Compressive Strength of Cement.
5. Determination of Fineness modulus of Coarse and Fine Aggregates.
6. Determination of percentage of voids, Bulk density, Specific Gravity of coarse and Fine Aggregates.
7. Workability Tests: Slump Cone Test, Compaction factor test, Vee-Bee consistometer Test.
8. Preparing and curing concrete specimens for tests & Determination of compressive strength of concrete cubes.
9. Study of stress - strain characteristics of concrete and tests for tensile strength of concrete.
10. Experiments to demonstrate the use of non-destructive test equipment.
11. Mix Design: IS Code method.

Reading:

1. Properties of Concrete, AM Nevelli – 5th Ed, Prentice Hall Publishers, 2012.
2. Concrete Technology, M. S. Shetty – S Chand Co., Publishers, 2006.
3. Concrete Technology, M. L. Gambhir – Tata Mc Graw Hill Publishers, 2012.

SM335	ENGINEERING ECONOMICS AND ACCOUNTANCY	HSC	3 – 0 – 0	3 Credits

Prerequisites: None.

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

CO1	Prepare accounting records and summarize and interpret the accounting data for managerial decisions
CO2	Understand the macro-economic environment of the business and its impact on enterprise
CO3	Understand cost elements of the product and its effect on decision making
CO4	Understand the concepts of financial management and smart investment

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	-	1	-	-	1	-	1	1
CO2	-	1	-	-	1	-	1	1
CO3	-	-	-	-	2	-	1	1
CO4	-	-	-	-	1	-	-	-

Detailed Syllabus:

Engineering Economics: Introduction to Engineering Economics – Fundamental concepts – Time value of money – Cash flow and Time Diagrams – Choosing between alternative investment proposals – Methods of Economic analysis. The effect of borrowing on investment- Various concepts of National Income – Significance of National Income estimation and its limitations, Inflation –Definition – Process and Theories of Inflation and measures to control, New Economic Policy 1991 – Impact on industry.

Accountancy: Accounting Principles, Procedure – Double entry system – Journal – Ledger, Trail Balance – Cash Book – Preparation of Trading, Profit and Loss Account – Balance sheet.

Cost Accounting – Introduction – Classification of costs – Methods of costing – Techniques of costing – Cost sheet and preparation of cost sheet- Breakeven Analysis – Meaning and its application, Limitations.

Reading:

1. Engineering Economic Principles, Henry Malcom Stenar- McGraw Hill Pub.
2. “Modern Economic Theory”, Siltan Chand & Co.
3. Agrawal AN, “Indian Economy”, Dewett K.K., - Wiley Eastern Ltd, New Delhi.
4. “Accounting Part-I’, Jain and Narang - Kalyani Publishers.
5. “Cost Accounting”, Arora, M.N. - Vikas Publications.

CE301	THEORY OF STRUCTURES - I	PCC	4 – 0 – 0	4 Credits

Prerequisites: Mechanics of Materials.

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

CO1	Formulate Equilibrium and compatibility equations for structural members
CO2	Analyze one dimensional and two dimensional problems using classical methods
CO3	Analyze indeterminate structures
CO4	Analyse structures for gravity loads, moving loads and lateral loads

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	-	-	3	-	-	-	1
CO2	3	-	-	3	-	-	-	1
CO3	3	-	-	3	-	-	-	1
CO4	3	-	-	3	-	-	-	1

Detailed Syllabus:

Fixed and Continuous beams: Analysis of fixed and continuous beams for shear force and bending moment-Statement of Clapeyron's theorem of three moments - deflection of fixed beams - effect of sinking of supports.

Column Analogy Method: Principle - Application to fixed beams - Application to non-prismatic members - stiffness coefficients.

Slope - Deflection Method: Principle of the method - analysis and application to continuous beams - portal frames (single bay - Single storey).

Moment-Distribution Method: Principle of the method - analysis of continuous beams and portal frames (single storey - single bay).

Moving Loads: Maximum bending moment and shear force diagrams for simply supported spans traversed by single point load - two concentrated loads - Uniformly distributed load, shorter and longer than the span - enveloping parabola and equivalent uniformly distributed load, determination of maximum bending moment and shear force for a system of concentrated loads on simply supported girders - focal length of a girder - counter bracing.

Influence Lines: (a) Influence lines for reaction bending moment and shear force diagrams for simply supported beams - stresses in members of statically determinate pin jointed plane frames due to moving loads.

Reading:

1. L.S. Negi, Theory and Problems in Structural Analysis, Tata McGraw Hill Pub, 1997.

2. Junarkar. S. B and Shah H.J- Mechanics of Structures Vol 1 & Vol.2 – 27th Edition, Charotar Publishers, 2008.
3. Wang C.K. - Intermediate Structural Analaysis – Tata Mc Graw Hill Publishers, 2010.

CE302	DESIGN OF CONCRETE STRUCTURES – I	PCC	4 – 0 – 0	4 Credits

Prerequisites: Concrete Technology and Mechanics of Materials.

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

CO1	Design the Reinforced Concrete beams using limit state and working stress methods
CO2	Design Reinforced Concrete slabs
CO3	Design the Reinforced Concrete Columns and footings
CO4	Design structures for serviceability
CO5	Design stair cases, canopy, retaining wall and water tanks

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	1	-	3	-	-	-	1
CO2	3	1	-	3	-	-	-	1
CO3	3	1	-	3	-	-	-	1
CO4	3	1	-	3	-	-	-	1
CO5	3	1	-	3	-	-	-	1

Detailed Syllabus:

Introduction- Review of Concrete making materials- Structural concrete- Grades- properties of Concrete- Modulus of elasticity-flexural strength-Characteristic and Design values-Partial safety factor.

Methods of design- Aims of design- RCC- Limit State method- Assumptions- Stress-Strain behavior of Steel and Concrete- Stress block parameters- Working stress method- comparison of design process.

Analysis and Design of Singly Reinforced Beams- Analysis of Singly Reinforced RC Section-Neutral axis-Balanced-Under Reinforced-Over Reinforced Sections- Moment of Resistance-Design parameters- Design examples.

Analysis and Design of Doubly Reinforced Beams- Necessity of Doubly Reinforced sections-Analysis of Doubly Reinforced RC Section-Moment of Resistance- Design parameters- Design.

Shear and Bond design of RCC- Shear forces in RC-Shear Resistance of RC- Truss analogy-design of Vertical stirrups-Bent-up bars- Limitation- Bond failure in RC- Check for bond resistance-Development length-Design for shear and bond.

Analysis and Design of Flanged Beams- Analysis of flanged RC section- Singly and Doubly reinforced-Effective flange width- Moment of Resistance- design examples.

Design of RCC Slabs- Design of One and Two way slabs- Effect of edge conditions- Moment of resistance-Torsion reinforcement at corners- Design examples.

Design of Continuous Slab and Beams- Effect of continuity- analysis of continuous beam/slab-Moment and shear coefficients for continuous beam/slab- Critical sections.

Design of RC Columns- Design principles of RC columns- Assumptions- Rectangular and Circular columns- Helical reinforcement- Minimum eccentricity-Use of Interaction diagrams for Axial load and Moment.

Design of RC Footings- RC footings-Minimum depth of footing- Safe bearing capacity- Design for Bending-Shear in One way and Shear in Two way- Transfer of load at base of column.

Design for Serviceability- Concept of Serviceability- Deflection- Span to depth ratio- Short term-Long term deflection due to Shrinkage, Creep- Cracking-Crack width calculation.

Design of Miscellaneous RC Structures- Design of Stair case – Design of Canopy Slab and Beam – Design of cantilever Retaining walls- Design of RC Circular Water tank- Design of single story RC Building.

Reading:

1. IS-456-2000, IS 3370(Part-IV), BIS 2000.
2. Design of Reinforced Concrete Structures (Limit State) – A.K.Jain, 1st Edition, Nemchand Brothers, Roorkee.
3. P.C. Verghese, Limit State Design of Reinforced Concrete, 2nd Edition, PHI, 2009.

CE303	ENGINEERING HYDROLOGY	PCC	4 – 0 – 0	4 Credits

Prerequisites: Fluid Mechanics – II.

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

CO1	Analyse hydro-meteorological data
CO2	Estimate abstractions from precipitation
CO3	Compute yield from surface and subsurface basin
CO4	Develop rainfall-runoff models
CO5	Formulate and solve hydrologic flood routing models

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	-	-	-	2	-	-
CO2	3	3	-	1	-	-	-	-
CO3	3	1	-	3	2	-	1	2
CO4	2	2	-	2	2	3	-	2
CO5	1	1	-	-	2	3	-	2

Detailed Syllabus:

Introduction- Description of Hydrologic Cycle, Overview of application of hydrology in engineering.

Forms and types of precipitation, basic concepts of weather systems, characteristics of precipitation in India.

Precipitation- Measurement of precipitation, types of rain gauges, rain gauge network, collection and presentation of rainfall data, Test for consistency and continuity of data, analysis of rainfall data, average precipitation over an area, intensity-duration-frequency analysis and depth-area-duration analysis.

Abstractions from Precipitation- Evaporation and Evaporation Process, measurement, estimation and control of evaporation, Evapotranspiration, measurement and estimation of evapotranspiration, interception and depression storage, Infiltration process, measurement of infiltration, infiltration models and infiltration indices and effective rainfall.

Stream Flow Measurement- Methods of measurement of stream flow, stage-discharge relationship, Runoff characteristics, catchment characteristics effecting the runoff, yield from a catchment, flow duration curve and flow mass curve.

Hydrograph Theory- Components of hydrograph, base flow separation, direct runoff hydrograph, Unit hydrograph theory, derivation of unit hydrograph, S-hydrograph and

instantaneous unit hydrograph, Derivation of unit hydrograph for ungauged catchments, conceptual models, synthetic unit hydrograph and its derivation.

Floods- Estimation of peak discharge, rational method, SCS method and unit hydrograph method, Design flood, return period, flood frequency analysis, probabilistic and statistical concepts. Gumbel's and log Pearson Type III methods.

Flood Routing- Concepts of flow routing, hydraulic and hydrologic routing, Reservoir routing, Channel routing, Muskingum and Muskingum-Cunge methods of channel routing and flood forecasting.

Groundwater- Occurrence of groundwater, types of aquifers, aquifer properties, Groundwater movement, Darcy's law, Conductivity and Transmissivity, yield from a well under steady state conditions, Pumping tests, unsteady flow in unconfined aquifers, well losses and specific capacity.

Reading:

1. Subrahmanya, K., 2008, Engineering Hydrology, Tata Mc Graw Hill Pub. Co., New Delhi.
2. Chow, V. T., Maidment and Mays, L. A., 2010, Applied Hydrology, Tata Mc Graw Hill Pub. Co., New York.
3. Viesmann W and Lewis G Lt (2008) "Introduction to Hydrology". Prentice Hall of India.

CE304	GEOTECHNICAL ENGINEERING - I	PCC	4 – 0 – 0	4 Credits

Prerequisites: Fluid Mechanics – II and Mechanics of Materials.

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

CO1	Characterise and classify soils
CO2	Identify shear strength parameters for field conditions
CO3	Compute and analyze the consolidation settlements
CO4	Understand the principles of compaction and its control

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	1	-	3	-	-	-	-
CO2	3	3	-	2	-	-	-	-
CO3	3	1	-	3	-	-	-	-
CO4	3	3	-	3	-	-	-	-

Detailed Syllabus:

Introduction: Soil formation- Development of soil mechanics- Importance of soil engineering- Major soil deposits of India.

Basic Definitions and Relationships: 3-phase soil system, volumetric relationships and weight - volume relationships.

Determination of Index Properties: Water content, Specific gravity, Grain size distribution by sieve and hydrometer analysis, Relative density, Atterberg's limits and indices.

Classification of Soils: Classification of soil systems – Particle size classification, Textural classification, AASHTO classification, Unified soil classification and Indian soil classification- Field identification of soils.

Soil Water: Types of soil water, Capillarity in soils, Permeability of soils, Darcy's law, Determination of permeability of soils, Permeability of stratified soils, Seepage velocity, Absolute coefficient of permeability, Factors affecting permeability- Effective stress principle- Effective stress under different field conditions- Seepage pressure-Quick sand condition.

Compaction of Soils: Definition and importance of compaction – Standard Proctor compaction test, Modified compaction test- Factors affecting compaction- Influence of compaction on soil properties – Field compaction and its control.

Stress distribution in Soils: Importance of estimation of stresses in soils – Boussinesq's and Westergaard's theories for point loads, uniformly loaded circular and rectangular areas, pressure bulb, variation of vertical stress under point load along the vertical and horizontal planes – Newmark's influence chart.

Consolidation: Types of compressibility, Types of compressibility – Immediate settlement – Primary consolidation and secondary consolidation – Stress history of clay, normally consolidated soil, over consolidated soil and under consolidated soil- preconsolidation pressure and its determination- Estimation of settlements -Terzaghi's 1-D consolidation theory – Coefficient of consolidation and its determination.

Shear Strength: Definition and use of shear strength - Source of shear strength- Normal and Shear stresses on a plane – Mohr's stress circle- Mohr-Coulomb failure theory- Measurement of shear strength, Drainage conditions -Direct shear test, Triaxial shear test, Unconfined compression test and vane shear test – Factors affecting shear strength of granular soils and cohesive soils.

Stability of Soil Slopes: Types of slopes – Types of slope failures – Slip circle method, Determination of centre of most critical slip circle – Taylor's stability charts and their use. Stabilisation of soil slopes.

Reading:

1. "Basic and Applied Soil Mechanics" by Gopal Ranjan and A.S.R. Rao, Wiley Eastern Ltd., New Delhi, 2009.
2. "Soil Mechanics and Foundation Engg" by V.N.S. Murthy, CBS Pub. New Delhi. 2007.

CE305	ENGINEERING GEOLOGY	PCC	3 – 0 – 0	3 Credits

Prerequisites: None.

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

CO1	Understand weathering process and mass movement
CO2	Distinguish geological formations
CO3	Identify geological structures and processes for rock mass quality
CO4	Identify subsurface information and groundwater potential sites through geophysical investigations
CO5	Apply geological principles for mitigation of natural hazards and select sites for dams and tunnels

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	2	-	3	1	-	-	-	-
CO2	2	3	3	2	2	-	1	2
CO3	2	3	3	3	2	2	1	2
CO4	-	2	2	2	2	1	2	2
CO5	3	-	2	3	2	-	2	3

Detailed Syllabus:

General Geology: Branches and scope of geology, Importance of geology in Civil engineering. Earth-surface features and internal structure, weathering of rocks.

Mineralogy: Definition of a crystal and mineral, physical properties in mineral identification, rock forming minerals and their identification – quartz and its varieties, feldspar, hornblende, olivine, mica, garnet, kyanite, calcite, talc, bauxite, corundum, gypsum, fluorite, apatite, beryl, barite, asbestos, magnetite, hematite.

Petrology: Formation and classification of rocks – Igneous, Sedimentary and metamorphic rocks, their texture and structures, properties of granite, pegmatite, dolerite, gabbro, charnockite, basalt, sandstone, conglomerate, breccia, limestone, shale, laterite, schist, gneiss, quartzite, marble, khondalite and slate. Drilling Techniques, Core Recovery, RQD, Engineering Properties of Rocks

Structural Geology: Outcrop, Strike and dip, types and classifications of folds, faults, joints, unconformities.

Engineering properties of rocks: Drilling, Core recovery, RQD, Sample preparation, tests on rock samples - compression, tensile, shear and slake durability tests.

Ground Water: Water tables, aquifers, occurrence of ground water in different geological formations, springs, selection of a site for well sinking and ground water investigations.

Earthquakes and Landslides: Causes and effects of earthquakes and landslides, Remedial measures to prevent damage for engineering structures.

Subsurface Investigations: Soil Profile, Geophysical methods – Electrical Resistivity and Seismic refraction methods.

Dams: Types of dams, Requirements of dam sites, preliminary and detailed geological investigations for a dam site. Case histories of dam failures and their causes. Geology of the major dam sites of India. Factors affecting the seepage and leakage of reservoir and the remedial measures.

Tunnels: Purpose of tunneling, geological considerations for tunneling, geothermal step, over break, stand up time, and logging of tunnels.

Reading:

1. K.V.G.K. Gokhale, “Principles of Engineering Geology”, BS Publications, Hyderabad, 2005.
2. David George Price, “Engineering Geology: Principles and Practice”, Springer, 2009.
3. Chennakesavulu, N., “Text book of Engineering Geology”, Mac Millan Ltd., New Delhi, 2009.
4. Parbin Singh., “Engineering and General Geology”, Katson Publishers, 2009.

CE306	GEOTECHNICAL ENGINEERING LABORATORY	PCC	0 – 0 – 3	2 Credits

Prerequisites: None.

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

CO1	Determine index properties of soils
CO2	Classify soils
CO3	Determine engineering properties of soils

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	-	3	3	2	-	-	-	1
CO2	-	2	2	3	-	-	-	1
CO3	-	2	2	3	-	-	-	1

Detailed Syllabus:

1. Specific Gravity of soil particles.
2. Sieve Analysis.
3. Liquid Limit, Plastic Limit & Shrinkage Limit.
4. Proctor's Standard Compaction Test.
5. Determination of Field Density.
6. Constant Head Permeameter Test.
7. Variable Head Permeameter Test.
8. Unconfined Compression Test.
9. Triaxial Compression Test (U.U Test).
10. Consolidation Test.

Reading:

- Soil Mechanics Laboratory Manual.

CE307	ENGINEERING GEOLOGY LABORATORY	PCC	0 – 0 – 3	2 Credits

Prerequisites: None.

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

CO1	Identify minerals and rocks

CO2	Measure strike and dip of the bedding planes
CO3	Interpret geological maps

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	-	2	3	3	2	1	1	1
CO2	2	3	2	2	2	1	2	2
CO3	1	3	2	2	2	-	1	1

Detailed Syllabus:

1. Introduction to Crystallography – Identification of Crystals.
2. Introduction of minerals and the study of Physical properties, Identification of Quartz and feldspars.
3. Identification of pyroxenes and Amphiboles and other silicates.
4. Identification of important economic minerals.
5. Identification of important ore deposits.
6. Identification of Igneous rocks.
7. Identification of Sedimentary rocks.
8. Identification of metamorphic rocks.
9. Structural geology- strike and dip, three and 3-point problems point problems.
10. Structural geology – Completion of out crops maps, order of superposition.
11. Subsurface analysis – Resistivity sounding.
12. Subsurface analysis – Seismic survey.

Reading:

1. Chennakesavulu, N., “Text book of Engineering Geology”, MacMillan Ltd., New Delhi, 2009.
2. Structural Geology Manual.

CE351	THEORY OF STRUCTURES - II	PCC	3 – 0 – 0	3 Credits

Prerequisites: Theory of Structures – I.

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

CO1	Formulate Equilibrium and compatibility equations for structural members
CO2	Analyze one dimensional and two dimensional structures using matrix methods of structural analysis
CO3	Analyze structures up to three degrees of indeterminacy
CO4	Analyze cables and suspension bridges
CO5	Determine dynamic parameters for single degree of freedom vibration problems

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	-	-	3	-	-	-	1
CO2	3	-	-	3	-	-	-	1

CO3	3	-	-	3	-	-	-	1
CO4	3	-	-	3	-	-	-	1
CO5	3	-	-	3	-	-	-	1

Detailed Syllabus:

Kani's Method: Application to continuous beams - yielding of supports - portal frames (Single bay - Single Storey) with and without side sway.

Deflection of Pin Jointed Plane Trusses: Deflection of Simple Plane trusses using Castigliano's theorem No. 1 - Deflections due to thermal changes

Analysis of Indeterminate Pin Jointed Plane Trusses: Castigliano's theorem No. 2 - Solution of statically indeterminate plane trusses with a maximum of two degrees of redundancy (both external and internal) - assembly stresses due to lack of fit - stress due to temperature variations.

Matrix Methods of Structural Analysis: Basic structural principles - static and kinematics indeterminacies of a structure - flexibility and stiffness matrices - flexibility and stiffness influence coefficients.

Matrix Force (Flexibility) Method: Basic principles - choice of redundants - released structure - application of fixed beams, continuous beams and portal frame upto two degree static indeterminacy.

Matrix Displacement (Stiffness) Method: Concept of stiffness method - restrained structure - applications to continuous beams and portal frames upto two degree of kinematic indeterminacy.

Reading:

1. Junarkar. S. B and Shah H.J- Mechanics of Structures Vol 1 & Vol.2 – 27th Edition, Charotar Publishers, 2008.
2. Mario Paz, Structural Dynamics-Theory and Computation, 2nd Edition, CBS Publishers, 2010.
3. Wang C.K. - Intermediate Structural Analysis – Tata Mc Graw Hill Publishers, 2010.

CE352	IRRIGATION ENGINEERING	PCC	4 – 0 – 0	4 Credits

Prerequisites: Engineering Hydrology.

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

CO1	Plan an Irrigation System
CO2	Design irrigation canals and canal network
CO3	Plan and design diversion head works
CO4	Design irrigation canal structures
CO5	Analyze gravity and earth dams
CO6	Design spillways and energy dissipations works

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	2	2	-	3	1	-	2	2
CO2	2	-	-	3	-	-	-	1
CO3	2	2	-	3	1	-	-	1
CO4	2	2	-	3	1	-	-	1
CO5	3	1	1	3	-	-	-	1
CO6	2	2	-	3	-	-	-	-

Detailed Syllabus:

Irrigation Systems: Types of irrigation systems, Soil moisture, Irrigation water requirements, Irrigation efficiencies, Methods of application of irrigation water, Water logging.

Canal Systems: Types of canals, Principles of design of stable irrigation canals, Silt theories, Tractive force theory, Design of lined canal, Design of longitudinal section.

Surface and subsurface flow analysis in hydraulic structures: Hydraulic structures on permeable foundations, Seepage theories, Principles of design of hydraulic structures on permeable foundation, Principles of energy dissipation.

Design of diversion head works: Types of hydraulic structures, Layout of a diversion head work, Design of vertical drop weir, Design of sloping glacis weir.

Design of Canal Structures: Canal regulators, Types of canal falls, Design of Sarda type fall, Design of straight glacis fall, Types of cross drainage works, Design of canal fluming, Design of aqueduct/ syphon aqueduct.

Gravity Dams: Types of storage head works, Forces acting on gravity dams, Analysis of gravity dams, Profile of a gravity dam.

Earth dams: Types of earth dams, Causes of failure of earth dams, Seepage analysis, Seepage control, Stability analysis.

Spillways and energy dissipation systems: Types of spillways, Design of Ogee spillway, Design of stilling basins.

Reading:

1. Modi P.M, Irrigation Water Resources and Hydropower Engineering, Standard Publishing Company, New Delhi, 2000.
2. Arora K.L. Irrigation Water Resources Engineering, Standard Book Publishing Co., Delhi, 1996.
3. Asawa G.L., Irrigation and Engineering, New Age Publishing Co., Delhi, 1996.
4. Murthy C.S.N., Water Resources Engineering – Principles and Practice, New Age Publishing Company, Delhi, 2002.

CE353	ENVIRONMENTAL ENGINEERING	PCC	4 – 0 – 0	4 Credits

Prerequisites: Chemistry and Engineering Hydrology.

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

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

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	3	-	-	-	2	-
CO2	2	2	-	-	-	3	2	-
CO3	3	2	-	3	2	-	2	1
CO4	3	2	-	3	2	-	2	1

Detailed Syllabus:

Sources, Quality and Quantity Perspectives of Water: Surface sources, subsurface sources, physical characteristics, chemical characteristics, biological characteristics, water quantity estimation, water consumption rate, fluctuations in rate of demand, design periods, population forecasting methods.

Collection and Conveyance of Water: Intakes, types of Intakes, factors governing location of intakes, pumps, types of conduits, types of pipes, pipe appurtenances

Purification of Water – Water Treatment: Operations involved in water treatment, screening, plain sedimentation, sedimentation aided with coagulation, filtration, disinfection, water softening, miscellaneous treatments.

Distribution System: Requirements of a good distribution system, methods of distribution, systems of supply of water, Distribution reservoirs, layout of distribution system, design of distribution system, analysis of pipe networks of distribution system, appurtenances in distribution system, detection and prevention of wastage of water in a distribution system.

Quality and Quantity Perspectives of Sewage: Physical, chemical and biological characteristics of sewage, analysis of sewage, estimation of dry weather flow, estimation of storm water flow.

Sewers and sewer appurtenances: Hydraulic design of sewers: hydraulic formulae for design of sewers, minimum velocity of flow in sewers, maximum velocity of flow in sewers, effect of variation in flow of sewage on velocity of flow in sewers, forms of sewers, design of storm water drains. Construction of sewers: factors affecting the selection of material for sewer construction, materials for sewers, joints in sewers, shapes of sewers, maintenance, cleaning & ventilation of sewers. Sewer appurtenances.

Treatment of sewage: Preliminary & primary treatment of sewage: screening, grit removal basins, tanks for removal of oil and grease, sedimentation, sedimentation aided with coagulation. Secondary treatment of sewage: activated sludge process, sewage filtration, miscellaneous methods such as oxidation ditch, oxidation ponds, aerated lagoons, rotating biological

contractors. Treatment and disposal of sludge, on-site disposal methods, advanced sewage treatment, treated effluent disposal & reuse.

Reading:

1. Peavy, H.S, Rowe, D.R., and G. Tchobanoglous (1985), Environmental Engineering, McGraw Hill Inc., New York.
2. P.N. Modi (2006), Water supply Engineering – Environmental Engineering (Vol.I) – Standard Book House.
3. S.K. Garg (1999), Water supply Engineering – Environmental Engineering (Vol.I) – Khanna Publishers.
4. P.N. Modi (2008), Sewage treatment & Disposal and waste water Engineering – Environmental Engineering (Vol.II) – Standard Book House.
5. S.K. Garg (1999), Sewage Disposal and Air Pollution Engineering – Environmental Engineering (Vol.II) – Khanna Publishers.
6. Metcalf & Eddy, Inc. (2003), Waste water Engineering Treatment and Reuse, McGraw Hill Inc., New Delhi.
7. Masters, G.M. (1994), Introduction to Environmental Engineering and Science, Prentice Hall of India, New Delhi.
8. Ruth F. Weiner and Robin A. Matthews (2003), Environmental Engineering, Butterworth-Heineman.
9. Nicholas P. Cheremisinoff (2002), Handbook of Water and Wastewater Treatment Technologies, Butterworth- Heineman.

CE354	TRANSPORTATION ENGINEERING	PCC	4 – 0 – 0	4 Credits

Prerequisites: None.

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

CO1	Plan highway networks
CO2	Design highway geometrics.
CO3	Design Intersections and prepare traffic management plans.
CO4	Design flexible and rigid pavements.
CO5	Understand the principles of construction and maintenance of highways

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	-	3	-	-	-	3	-	-
CO2	-	3	-	3	-	3	-	-
CO3	-	3	-	3	1	2	-	-
CO4	3	-	3	3	-	-	-	-
CO5	-	-	-	-	3	-	-	-

Detailed Syllabus:

Highway Network Planning: Different modes of transportation, role of highway transportation, classification, network patterns, planning surveys, preparation of plans, final report, master plan, evaluation by saturation system, 20 year road development plans, salient features, determination of road lengths, introduction to highway economics.

Highway Alignment and Geometric Design: Principles of highway alignment, requirements, controlling factors, engineering surveys, importance of geometric design, design controls and criteria, cross section elements, pavement surface characteristics, camber, carriageway, kerbs, road margins, formation, right of way, typical cross sections. Sight distance, stopping sight distance, overtaking sight distance, sight distance at intersections. Design of horizontal alignment, super elevation, transition curves. Design of vertical alignment, gradients, vertical curves.

Traffic Engineering Principles: Traffic characteristics; components of traffic stream: flow-speed-Density, measurement and analysis, q-k-v relationships, design hourly volume, concept of EPCU, capacity and level of service. Parking studies and accident studies. Design of intersections, at grade intersections, channelized and rotary. Introduction to grade separated intersections, cloverleaf, trumpet, flyovers.

Traffic Management and Control: Traffic regulations, one-way streets, traffic signs, road markings, signals, warrants. Design of isolated fixed time signal, introduction to signal coordination.

Pavement Materials and Mix Design: Subgrade soil properties, CBR test, aggregates, desirable properties, tests, bituminous materials, bitumen and tar, tests. Bituminous mixes, requirements, design, Marshall Method.

Design of Pavements: Types of pavement structures, functions of pavement components, design factors. Design of flexible pavements, methods, GI method, CBR method, IRC method, Burmister's method. Design of rigid pavements, design considerations, wheel load stresses, temperature stresses, frictional stresses, design of joints, IRC method of rigid pavement design.

Highway Construction: Types of highway construction, construction of earth roads, gravel roads, WBM roads. Bituminous pavements, types, surface dressing, penetration macadam, built up spray grout, bitumen bound macadam, bituminous carpet, bituminous concrete. Cement concrete pavements.

Highway Maintenance: Pavement failures, causes, failures in flexible pavements and rigid pavements. Maintenance of highways, routine maintenance, periodic maintenance, special

repairs. Strengthening of existing pavements, evaluation, overlay design. Highway drainage, surface and sub-surface drainage.

Reading:

1. Kadiyali L.R. Traffic Engineering and Transport Planning, Khanna Publishers, New Delhi, India, 1997.
2. Khanna, S.K. and C.E.G. Justo Highway Engineering, Nem Chand and Bros, Roorkee, India, 2001.
3. Ministry of Road Transport and Highways. Specifications for Road and Bridge Works, Fourth Edition, Indian Roads Congress, New Delhi, India, 2001.
4. IRC Codes of Practices
5. Papacostas C.S. and PD Prevedouros. Transportation Engineering and Planning, Third Edition. Prentice Hall of India Pvt. Ltd, New Delhi, India, 2002.
6. Jotin Khisty C. and B. Kent Lall. Transportation Engineering – An Introduction, Third Edition. Prentice Hall of India Pvt. Ltd, New Delhi, India, 2002.
7. Chakroborty, P. and A. Das Principles of Transportation Engineering, Prentice Hall of India Pvt. Ltd, New Delhi, India, 2005.
8. Rao G.V. Principles of Transportation and Highway Engineering, Tata McGraw-Hill Publishing Company Ltd., New Delhi, India, 1996.
9. McShane, W.R. and R.P. Roess Traffic Engineering, Prentice Hall, New Jersey, USA, 1990.
10. Huang, Y.H. Pavement Analysis and Design, Pearson Prentice Hall, New Jersey, USA, 2004.

CE355	GEOTECHNICAL ENGINEERING - II	PCC	3 – 0 – 0	3 Credits

Prerequisites: Geotechnical Engineering – I.

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

CO1	Determine the earth pressures on foundations and retaining structures
CO2	Analyze shallow and deep foundations
CO3	Calculate the bearing capacity of soils and foundation settlements
CO4	Understand soil exploration methods

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	-	-	-	-	-	-	-
CO2	3	3	-	-	3	-	-	-
CO3	-	-	-	3	3	2	-	-
CO4	-	-	-	-	-	3	-	-

Detailed Syllabus:

Lateral Earth Pressures: Lateral earth pressure theory, Different types of earth pressures, Rankine's active and passive earth pressures, pressure distribution diagram for lateral earth pressures against retaining walls for different conditions in cohesionless and cohesive soils, Coulomb's active and passive earth pressure theory, Culmann's graphical construction, Problems.

Bearing capacity of foundation: Bearing capacity – Basic Definitions, Factors affecting bearing capacity, Estimation of Bearing capacity by different methods, Analytical measures – Terzaghi's and Meyerhof methods and calculations, Field measures – SPT, CPT and Plate load tests.

Settlement of foundation: Settlement analysis – Types of foundation settlement, Components of settlements - their estimation, Allowable settlement values, Effects, Causes and remedial measures of total and differential settlements

Shallow foundations: Types of shallow foundations and choice, basic requirements, Significance of these foundations

Pile foundations: Classification and uses, Load carrying capacity calculations by different methods – static methods, dynamic methods, in-situ penetration tests, piles load test; Negative skin friction; under reamed pile foundations; Pile groups – Necessity, Efficiency, Group capacity and settlements.

Well foundations; Types of casissons and their construction; Different shapes of wells, component parts and forces; Estimation of bearing capacity; sinking of wells and remedial measures for tilts and shifts.

Soil Exploration: Introduction and different methods – Direct methods, Semi-direct and Indirect methods; Sampling in soils and rocks; subsurface exploration program - Preparation of bore logs and preparation of exploration report

Reading:

1. Murthy V.N.S (2007): Soil Mechanics and Foundation Engineering – CBS publications, Delhi.
2. Das, BM (2009): Geotechnical engineering – Cengage learning, New Delhi.
3. Gopal Ranjan, Rao ASR (2000): Basic and applied soil mechanics – New age publication, Delhi.
4. Iqbal H Khan (2007): Geotechnical Engineering – Prentice Hall, Delhi.

CE356	**ENVIRONMENTAL ENGINEERING LABORATORY**	**PCC**	**0 – 0 – 3**	**2 Credits**

Prerequisites: Chemistry Laboratory.

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

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

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	3	-	-	-	2	-
CO2	-	2	-	2	-	-	-	-
CO3	-	2	-	2	-	-	-	-
CO4	-	2	3	2	1	2	2	-

Detailed Syllabus:

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.

Reading:

1. Standard methods for the examination of water and wastewater. (2012). 21st Edition, Washington: APHA.

2. Sawyer, C. N., McCarty, P. L., and Perkin, G.F., Chemistry for Environmental Engineering and Science, 5th edition McGraw-Hill Inc., 2002
3. B. Kotaiah and Dr. N. Kumara Swamy, Environmental Engineering Laboratory Manual, Charotar Publishing House Pvt. Ltd., 1st Ed., 2007.

CE357	CIVIL ENGINEERING SOFTWARE LABORATORY	PCC	0 – 0 – 3	2 Credits

Prerequisites: None.

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

CO1	Understand the need for software tools in analysis and design of Civil Engineering Systems
CO2	Identify the available open source software tools used for specific problems in Civil Engineering
CO3	Use the latest software tools for Modeling, Analysis and Design of Civil Engineering Systems

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	-	1	-	2	1	2	-	-

CO2	-	1	-	2	1	2	-	-
CO3	2	3	1	3	2	3	1	2

Detailed Syllabus:

This laboratory provides training to the students in using popular software's for various Civil Engineering Applications as mentioned below.

S. No.	Software	Application
1	SAP	Structural analysis and Design
2	ETABS	Integrated Analysis, Design and Drafting of Building Systems.
3	Plaxis	Geotechnical modeling software
4	Civil 3D	Computer aided Drafting, used for all Civil Engineering Drawings
5	MxRoad Suite	Modeling software for Road & Highway design, Rehabilitation and Renewal
6	MIKE-SHE	Hydrologic and Hydraulic modeling
7	HEC-HMS	Hydrologic Modeling system
8	SWMM	Storm Water Management Model
9	SWAT	Soil and water Assessment Tool
10	EPANET	Hydraulic and water quality behavior of water distribution system
11	OPEN FOAM	Fluid flow Simulation and Analysis

Reading:

- Software manuals

CE401	QUANTITY SURVEYING AND PUBLIC WORKS	PCC	1 – 0 – 3	3 Credits

Prerequisites: Building Planning and Construction, Building Drawing, Engineering Economics and Accountancy**.**

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

CO1	Prepare quantity estimates for buildings, roads, rails and canal works
CO2	Calculate the quantity of materials required for civil engineering works as per specifications
CO3	Evaluate contracts and tenders in construction practices
CO4	Prepare cost estimates

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	2	-	3	-	-	-	-
CO2	-	2	-	-	3	-	-	-
CO3	-	3	-	-	-	-	-	-
CO4	-	3	-	-	3	-	-	-

Detailed Syllabus:

Introduction to estimates: Purpose of estimating; Different types of estimates - their function and preparation; Building estimates: Schedule of rates, Units of measurements, units of works; Road Estimates – Volume of earthwork, Different methods, Earthwork for hill roads; Railway and canal works – Estimates for a new track railway line; earthwork in canals.

Analysis of rates: Preparation for analysis of rates. Quantity of materials per unit rate of work, labour estimate.

Specifications: Necessity, types of specifications, specifications for different civil engineering materials.

Contracts: Essentials of contracts, types of engineering contracts – advantages and disadvantages.

Tenders: tender forms, tender documents & notices – time limits, necessity.

Valuation: Purpose, difference between value and cost, qualifications and functions of a valuer, scrap & salvage value, sinking fund, capitalised value.

Reading:

1. Chakraborti, M, Estimation, costing, specifications and valuation in civil engineering – National Halftone Co. Calcutta, 2005.
2. Dutta B.N., Estimation and costing in civil engineering: theory and practice – UBS Publishers Distributors Ltd, 2006.
3. Birdie, G.S. - Estimation and costing in civil engineering – Dhanpat Rai Publishing co. ltd.

CE402	TRANSPORTATION ENGINEERING LABORATORY	PCC	0 – 0 – 3	2 Credits

Prerequisites: Transportation Engineering.

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

CO1	Conduct traffic studies for estimating traffic flow characteristics
CO2	Characterize the pavement materials
CO3	Perform quality control tests on pavements and pavement materials
CO4	Estimate earth work from longitudinal and cross-section details
CO4	Design grade intersections

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	-	3	-	-	-	-	-	-
CO2	-	-	3	-	-	-	-	-
CO3	-	-	3	-	-	-	-	-
CO4	-	3	-	-	-	-	-	-
CO5	-	-	-	3	-	-	-	-

Detailed Syllabus:

Volume studies - Direction, duration and classification of traffic volume at mid-block section and intersections, manual and mechanical methods, and headway distributions.

Speed studies - Spot speed studies – radar speed meters.

Parking Surveys- Parking inventory and turnover studies and drivers characteristics.

Tests on Aggregates- Aggregates: Gradation- Shape tests-Aggregate Impact Test- Los Angeles Abrasion Test – Compressive strength of Aggregates- Specific Gravity Test and Water Absorption Test.

Tests on Bitumen- Penetration Test-Ductility Test- Softening point Test-Flash and Fire Point Test-Viscosity test- Marshall Stability Mix Design-Analysis, Binder content determination Design of Roundabout and earth work calculations.

Reading:

1. Mc Shane, WR and RP Roess, Traffic Engineering, Prentice Hall.
2. Pignataro LJ. Traffic Engineering: Theory and Practice; Prentice hall, Inc.
3. L.R. Kadiyali, Traffic Engineering and Transportation Planning, Khanna Publishers.

4. All laboratory tests are as per IS, ASTM, AASHTO, TRL, IRC, BS procedures / specifications and guidelines.

CE449	PROJECT WORK PART – A	PRC	0 – 0 – 3	2 Credits

Prerequisites:.

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

CO1	Work in a team to select a problem for project work
CO2	Review and evaluate the available literature on the chosen problem
CO3	Formulate the methodology to solve the identified problem
CO4	Apply the principles, tools and techniques to solve the problem

CO5	Prepare and present project report

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	2	2	2	2	2	2	1	1
CO2	2	2	2	2	2	2	2	3
CO3	3	1	1	3	3	2	1	1
CO4	3	3	3	3	3	3	3	3
CO5	-	-	-	-	-	-	3	2

EE485	**MEASUREMENT TECHNIQUES AND INSTRUMENTATION**	**ESC**	**3 – 0 – 0**	**3 Credits**

Prerequisites: Basic Electrical Engineering, Basic Electronic Engineering, Material Testing Laboratory, and Hydraulics Engineering Laboratory.

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

CO1	Apply concepts of transducers for measurement of physical quantities
CO2	Analyze the performance of physical systems using transducers
CO3	Evaluate the health monitoring of structures
CO4	Understand the principles of instruments used to measure climatological variables
CO5	Understand the principles of non-destructive testing methods

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	2	-	-	-	-	-	1	-
CO2	2	-	-	1	2	1	1	1
CO3	-	2	-	2	2	-	2	1
CO4	-	2	-	-	-	2	2	1
CO5	1	2	2	-	-	-	1	1

Detailed Syllabus:

Measurement Attributes: Measurement Systems and Characteristics, Transducers, Classification, Measurement of Pressure, Measurement of Torque, Measurement of Strain, Measurement of Velocity, Measurement of Acceleration, Measurement of Vibrations, Measurement of climatological variables, Principles of Non-Destructive Testing (NDT), Techniques and methods of testing for health monitoring structures, testing of composites.

Reading:

- K. Sawhaney, A course in Electrical Measurements Electronic Measurements Instrumentation, 17th Edition, Dhanpat Rai and Co, 2008.
- Doebelin, Measurement Systems, Applications and Design, Tata McGraw Hill, 2008.
- J. Prasad and CGK Nair, Non-Destructive Test and Evaluation of Materials, Tata McGraw Hill, 2008.
- Thomas G. Beckwith, Roy D. Marangoni and John H. Lienhard, Mechanical Measurements, 6th Edition, Prentice Hall, 2006.

Evaluation guidelines:

Sessionals : 20 Marks
Mid Semester Exam : 30 Marks
End Semester Exam : 50 Marks

CE451	CONSTRUCTION TECHNOLOGY AND PROJECT MANAGEMENT	PCC	3 – 0 – 0	3 Credits

Prerequisites: Engineering Economics and Accountancy**.**

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

CO1	Understand the roles and responsibilities of a project manager
CO2	Prepare schedule of activities in a construction project
CO3	Prepare tender and contract document for a construction project
CO4	Understand safety practices in construction industry
CO5	Identify the equipment used in construction

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	-	2	-	-	3	2	2	3
CO2	-	-	-	-	3	2	2	3
CO3	-	-	-	-	3	-	-	3
CO4	-	-	-	-	3	3	-	3
CO5	-	-	-	-	3	-	-	-

Detailed Syllabus:

Importance of Project Management, Role of Project manager, Stakeholders in construction project, Different types of projects, similarities & dissimilarities in projects., Time, Scope & Money, Knowledge areas & Processes involved in construction projects, WBS of a major work, with examples, Planning, monitoring & executing, Planning, sequencing, scheduling, Bar Charts, Networks, CPM, PERT, Upgrading, Cash flow diagram, resource levelling & resource allocation, Crashing of project, Cost Optimization, Invoicing, Preparation of RA bill, Safety in construction, Estimation, Tenders & Contracts.

Equipment for construction, Construction Finances – decision making, Construction of piles, Construction of Tunnels, Construction of cofferdams.

Reading:

1. Puerifoy R.L. - Construction Planning Equipment & methods.
2. Punmia and Khandelwal K.K. - Project Planning and Control - Laxmi Publ. Delhi.
3. Srivatsava, 1998. Management in Construction Industry.
4. Antil & Woodh - Critical Path Method in Construction - Wiley International.
5. Mahesh Varma - Construction Planning and Equipment - Metropolitan Co.

6. Choudhary S. - Project Management - Tata McGraw Hill Publishing Company Limited, New Delhi.

CE491	SEMINAR	MDC	0 – 0 – 2	1 Credit

Prerequisites: None.

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

CO1	Select a topic relevant to analysis, design and management of a civil engineering system
CO2	Undertake a critical review of the literature on the chosen topic
CO3	Prepare and present a technical report

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8

CO1	2	2	2	2	2	2	-	-
CO2	3	3	3	3	3	3	1	3
CO3	-	-	-	-	-	-	3	-

CE499	**PROJECT WORK PART – B**	**PRC**	**0 – 0 – 6**	**4 Credits**

Prerequisites: Engineering Economics and Accountancy**.**

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

CO1	Work in a team to select a problem for project work
CO2	Review and evaluate the available literature on the chosen problem
CO3	Formulate the methodology to solve the identified problem
CO4	Apply the principles, tools and techniques to solve the problem
CO5	Prepare and present project report

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	2	2	2	2	2	2	1	1
CO2	2	2	2	2	2	2	2	3

CO3	3	1	1	3	3	2	1	1
CO4	3	3	3	3	3	3	3	3
CO5	-	-	-	-	-	-	3	2

CE411	**PRESTRESSED CONCRETE**	**DEC**	**3 – 0 – 0**	**3 Credits**

Pre-requisites: Design of concrete structures.

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

CO1	Understand the concepts of pre-stressing in concrete structures and identify the materials for pre-stressing
CO2	Analyse a Pre-stressed Concrete section
CO3	Estimate losses of pre-stressing
CO4	Design pre-tensioned and post tensioned girders for flexure and shear
CO5	Design continuous pre-tensioned and post tensioned beams

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	2	-	2	-	1	-	-	1
CO2	1	-	-	3	-	-	-	1
CO3	1	1	-	2	-	-	-	-
CO4	-	-	-	3	-	-	-	1

CO5	-	-	-	3	-	-	-	1

Detailed Syllabus:

Introduction: Fundamentals of prestressing - Classification and types of prestressing- Concrete Strength and strain characteristics - Steel mechanical properties - Auxiliary Materials like duct formers.

Prestressing Systems: Principles of pretensioning and post tensioning - study of common systems of prestressing for wires strands and bars.

Losses of Prestress: Losses of prestress in pre tensioned and post tensioned members - I.S. code provisions.

Analysis of Sections: In flexure, simple sections in flexure, kern distance - cable profile - limiting zones - composite sections cracking moment of rectangular sections.

Design of Simply Supported Beams: Allowable stress as per I.S. 1343 - elastic design of rectangular and I-sections.

Shear and Bond: Shear and bond is prestressed concrete beams - conventional design of shear reinforcement - Ultimate shear strength of a section - Prestress transfer in pretensioned beams- Principles of end block design.

Reading:

1. Krishna Raju. N “Prestressed Concrete”, Tata Mc Graw Hill.
2. Lin.T.Y, “Prestressed concrete”, Mc Graw Hill Pub. Co.
3. Rajagopalan, “Prestressed concrete”, Narosa Publishing House.

CE412	INDUSTRIAL STRUCTURES	DEC	3 – 0 – 0	3 Credits

Pre-requisites: Design of steel structures.

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

CO1	Design steel gantry girders and portal frames
CO2	Design connections for different loading conditions
CO3	Design storage structures, bunkers and silos
CO4	Design light weight metal structures

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	-	-	-	3	-	-	-	1
CO2	-	-	-	3	-	-	-	-
CO3	-	-	-	3	-	-	-	-
CO4	-	-	-	3	-	-	-	1
CO5	-	-	-	3	-	-	-	1

Detailed Syllabus:

Detailed Design of Steel Gantry Girders.

Detailed Design of Portal Frames-Single bay two storey.

Detailed Design of Gable Structures.

Detailed Design of Knee Brace.

Detailed Design of Light weight metal structures.

Design of connections-Shear and Flexure Design.

Detailed Design of Steel Bunkers.

Detailed Design of Silos.

Detailed Design of Self Supported Chimneys.

Reading:

1. Design of Steel Structures, Arya and Azmani, Nem Chand Brothers, Roorkee, 2004

2. Punmia B.C, Ashok Kr. Jain, Arun Kr. Jain, RCC Designs (Reinforced Concrete Design), 10th Edition, Lakshmi Publishers, 2006.
3. Ramachandra, Design of Steel Structures, 12th Edition, Standard Publishers, 2009.

CE413	APPLIED STRESS ANALYSIS	DEC	3 – 0 – 0	3 Credits

Pre-requisites: Strength of Materials and Mathematical Methods.

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

CO1	Apply principles of elasticity theory to determine stresses and strains
CO2	Apply theory of elasticity and formulate plane stress and plane strain problems
CO3	Apply experimental techniques using strain gauges to solve field problems.

CO4	Apply principles of photoelasticity to solve elastic problems

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	2	-	-	2	-	-	-	1
CO2	2	-	-	2	-	-	-	1
CO3	2	2	-	2	-	-	-	1
CO4	2	3	-	1	-	-	-	1

Detailed Syllabus:

Introduction to Theory of Elasticity, Assumptions made in strength of materials and theory of Elasticity, Necessary and sufficient conditions for analyzing a structure, State of stress at a point, Specification of stress at a point-Determination of Normal thrust and Shear stress, Problems on Specification of stress at a point.

Concept of Orthogonal Transformation of axes and Problems, Determination of Stress invariants, Determination of Principal Stresses and Planes, Determination of Maximum Shear Stresses and their corresponding planesems, Tresca's criteria.

Derivation of Equilibrium conditions in three dimensions, Concept of Strain at a point, Determination of Normal and Shear Strain, Generalized Hooke's Law and problems on interrelationship between stress and Strain in three dimensions, Formulation of a stress analysis problem using the necessary and sufficient conditions in three dimensions and modifying the same to identify the unknowns in plane cases, Derivation of Airy's Stress function using the boundary conditions, equilibrium equations, compatibility conditions.

Solution to stress analysis problems, Torsion of circular shafts, Strain Measurement- Types of Strain gauges, Characteristics of ideal strain gauges, gauge factor, Strain gauge-Rosettes, Introduction to two dimensional photo elasticity, Stress-Optic law.

Reading:

1. Timoshenko and Goodier, Theory of Elasticity, 3rd Ed., McGraw Hill 2010.
2. Sadhu Singh, Applied Stress Analysis, 4th Edition, Khanna Publishers, New Delhi.
3. J.W. Dally and W.F.Riley, Experimental Stress Analysis, 3rd Edition, Mc Gram Hill.

CE414	STRUCTURAL DYNAMICS	DEC	3 – 0 – 0	3 Credits

Pre-requisites: Physics, Mathematical Methods and Engineering Mechanics.

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

CO1	Analyse single degree of freedom systems without damping and with damping
CO2	Analyse multi degree freedom system and continuous systems using iterative techniques.
CO3	Evaluate dynamic response using numerical methods
CO4	Draw mode shapes and determine coefficients

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8

CO1	2	-	-	3	-	-	1	2
CO2	2	-	-	3	-	-	1	2
CO3	2	-	-	3	-	-	1	2
CO4	2	-	-	1	-	-	-	1

Detailed Syllabus:

Steady state forcing functions - Damping Vibrations system - Greens Function for computing response under general type of excitation.

Multidegree of Freedom Systems: Free vibration - Determination of Natural frequencies and mode shapes - Vanello Stodola and Matrix iteration methods - Energy methods - Forced vibrations - Lagrange's equation - Simple applications.

Continuous Systems: Free and forced vibrations of beams - Approximate solutions - Rayleigh and Rayleigh - Ritz Methods - Vibrations of building frames - Model Analysis.

Numerical evaluation of dynamic response – Time stepping method – methods based of interpolation of excitation – central difference method – Newmark's method.

Reading:

1. Structural Dynamics - Theory & Computations - Mario Paz, Van Nostrand Co., Inc., 1980.
2. Vibration problems in Engineering - Timoshenko Van Nostrand Co., Inc., 1955.
3. Introduction to Structural Dynamics - Biggs McGraw Hill Book Co. 1975.
4. Dynamics of Structures - Clough & Penzien McGraw Hill Book Col, 1975.
5. Dynamics of structures - Hurty and Rubinsteian.
6. Dynamics of structures by A.K. Chopra – Prentice Hall – 1996.

CE415	BRIDGE ENGINEERING	DEC	3 – 0 – 0	3 Credits

Pre-requisites: Design of steel structures and Design of concrete structures.

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

CO1	Design the slab culvert, Box culvert
CO2	Design the T beam bridge and substructures
CO3	Design the Bridge bearings
CO4	Design the steel bridge for railways

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	-	-	-	3	-	-	-	1
CO2	-	-	-	3	-	-	-	1
CO3	-	-	-	3	-	-	-	1
CO4	-	-	-	3	-	-	-	1

Detailed Syllabus:

Reinforced Concrete Bridges: IRC Loading and impact factors, Design and detailing of slab bridge IRC effective width method, Design and detailing of simply supported T-beam bridge (without footpath) - Pigeaud's method for design of slab panels and Courbon's method of lateral distribution of live load in main beams, Design and detailing of single vent rectangular box culvert.

Drawings: (For Class Work Evaluation only)

Plan, Elevation and section of reinforced concrete slab, T Beam Bridge and Box Culvert with reinforcement details and bar bending schedule.

Steel Bridges: Introduction to steel bridges - deck and through types of bridges -economical spans - Indian standard broad gauge train loading - impact factor - permissible stresses, Design of railway plate girder - deck type of bridge for broad - gauge main line loading - wind bracing and cross frames - plate bearings, Design of railway through type truss bridge for broad gauge main line loading - design of various members including and post design of connections, Design of Piers and Abutments.

Reading:

1. Victor D.J - Essentials of bridge Engineering, Oxford and IBH Publishers.
2. Arya and Azmani - Design of steel structures, Nemchand Publishers.
3. I.R.C Codes, Railway bridge rules, Lucknow.

CE416	COMPUTATIONAL HYDRAULICS	DEC	3 – 0 – 0	3 Credits

Pre-requisites: Fluid Mechanics II.

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

CO1	Derive the governing equations of transients in pipes and channels
CO2	Apply method of characteristics and finite difference methods to solve unsteady flow problems in pipes and channels
CO3	Analyze transients in pumping and hydropower systems
CO4	Analyze dam break problem

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	2	-	-	-	2	-	-	1
CO2	-	-	-	-	2	2	-	1
CO3	-	-	-	-	2	2	1	1
CO4	-	-	-	-	2	2	-	1

Detailed Syllabus:

Basic concepts of Numerical integration, Application to reservoir volume calculations.

Classification of PDEs, Computational Methods, Finite Difference Methods, Finite Volume Methods, Ordinary Differential Equations, Various orders of Runge-Kutta methods. Applications to non-linear reservoir routing.

Development of gradually varied flow functions, Application to backwater curves and drawdown curves computation. Analysis of pipe networks, Hardy Cross method, Variable pressure pipe networks.

Unsteady pipe flows and free surface flows, Saint Venant's Equations, Solutions by the method of characteristics, Analysis of dam break problems.

Positive and negative surge analysis, design and analysis of surge shocks.

Reading:

1. Abbot, M.A. and Vervey, Computational Hydraulics, Elsevier Publications, 1996.
2. Hoffman, J.D., Numerical Methods for Engineers and Scientists, CRC Press, Special Indian Edition, 2011.
3. M.H. Choudhary, Applied Hydraulic Transients, Van Nostrand Reinhold, New York, 2013.

CE417	STOCHASTIC HYDROLOGY	DEC	3 – 0 – 0	3 Credits

Pre-requisites: Engineering Hydrology.

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

CO1	Differentiate and compare parameter estimation methods for frequency distributions used in hydrology
CO2	Apply multivariate analysis in hydrologic systems
CO3	Analyse hydrologic time series
CO4	Develop models for synthesis of hydrologic variables

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	-	-	-	-	-	2	-	1
CO2	-	-	-	2	-	2	-	1
CO3	-	-	-	2	-	2	-	1
CO4	-	-	-	2	-	2	-	1

Detailed Syllabus:

Deterministic and stochastic hydrology, types of problems in hydrology, need for statistical methods in hydrology, continuous and discrete distributions applied in hydrology, moments and expectations, parameter estimation by moments, probability weighted moments, least square methods and maximum likelihood methods, probability plotting, regional flood frequency analysis, hypothesis testing, linear and nonlinear regression.

Hydrologic time series analysis, modelling of hydrological time series, data generation techniques, auto regressive processes and models for operational hydrology.

Reading:

1. Charles T Han, Statistical Methods in Hydrology, East West Publishers, 1998.
2. Jayarami Reddy, Stochastic Hydrology, Laxmi Publications, 1997.

CE418	**INDUSTRIAL WASTE TREATMENT**	**DEC**	**3 – 0 – 0**	**3 Credits**

Pre-requisites: Environmental Engineering.

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

CO1	Identify the characteristics of industrial wastewaters
CO2	Describe pollution effects of disposal of industrial effluent
CO3	Identify and design treatment options for industrial wastewater
CO4	Formulate environmental management plan

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	-	2	-	-	-	2	1	1

CO2	-	-	-	-	-	1	1	1
CO3	-	-	-	3	-	-	1	2
CO4	-	-	-	-	-	-	1	1

Detailed Syllabus:

Introduction: Wastewater Characteristics, Standards of Disposal, Treatment Objective and, Strategies, Layouts of Primary, Secondary and Advanced Treatment Units.

Design of Preliminary and Primary Treatment Operations: Screens, Grit Chambers, Skimming Tank, Primary and Secondary Sedimentation Tanks.

Biological Treatment Processes: Types, Kinetics of Plug Flow and Completely Mixed Systems.

Attached Growth Processes: Trickling Filters (Standard Rate, High Rate), Biofilters, Practices, Features and Design, Operational Difficulties and Remedial Measures, Rotating Biological Contactors.

Suspended Growth Processes: Activated Sludge Process, Modifications and Design Equations, Process Design Criteria, Oxygen and Nutrient Requirements - Classification and Design of Oxidation Ponds, Lagoons.

Sludge Treatment and Disposal: Sludge Thickening, Aerobic and Anaerobic Sludge Digestion Processes, Design of Digester Tank, Sludge Dewatering, Ultimate Disposal, Sludge Drying Beds, Other Methods of Sludge Treatment.

Reading:

1. Metcalf and Eddy, Wastewater Engineering - Collection, Treatment, Disposal and Reuse, McGraw Hill Pub. Co., 1995.
2. Nelson Leonard Nemerow, Industrial Waste Treatment, Butterworth-Heinemann, 2007.
3. Benefield L.D. and Randall C.D. Biological Process Designs for Wastewater Treatment, Prentice Hall Pub. Co., 1980.

CE419	AIR POLLUTION	DEC	3 – 0 – 0	3 Credits

Pre-requisites: Physics and Fluid Mechanics II.

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

CO1	Identify sampling and analysis techniques for air quality assessment
CO2	Describe the plume behaviour for atmospheric stability conditions
CO3	Apply plume dispersion modelling and assess the concentrations
CO4	Design air pollution controlling devices

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	-	2	-	-	-	1	1	-
CO2	-	-	-	-	-	2	1	1
CO3	-	-	-	-	-	2	1	1
CO4	-	-	-	-	-	-	1	1

Detailed Syllabus:

Air Pollution: Definition of Air Pollution - Sources & Classification of Air Pollutants - Effects of air pollution - Global effects - Air Quality and Emission standards - Sampling of Pollutants in ambient air - Stack sampling

Meteorology and Air Pollution: Factors influencing air pollution, Wind rose, Mixing Depths, Lapse rates and dispersion - Atmospheric stability, Plume rise and dispersion, Prediction of air quality, Box model - Gaussian model - Dispersion coefficient - Application of tall chimney for Pollutant dispersion.

Control of Particulate Pollutants: Properties of particulate pollution - Particle size distribution - Control mechanism - Dust removal equipment - Design and operation of settling chambers, cyclones, wet dust scrubbers, fabric filters & ESP.

Control of Gaseous Pollutants: Process and equipment for the removal by chemical methods - Design and operation of absorption and adsorption equipment - Combustion and condensation equipment.

Reading:

1. Colls, J., Air Pollution: Measurement, Modeling and Mitigation, CRC Press, 2009.
2. Noel, D. N., Air Pollution Control Engineering, Tata McGraw Hill Publishers, 1999.
3. Stern, A.C., Fundamentals of Air Pollution, Academic Press, 1984.

CE420	IRRIGATION MANAGEMENT	DEC	3 – 0 – 0	3 Credits

Pre-requisites: None.

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

CO1	Plan irrigation systems and command area development programs
CO2	Evaluate the performance of an irrigation system
CO3	Plan measures for reclamation of water logged lands
CO4	Develop strategies for conflict management in irrigation projects

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	-	-	-	3	2	-	-	1
CO2	-	-	-	-	2	-	1	1
CO3	-	-	-	2	2	-	1	1
CO4	-	-	-	-	2	-	1	1

Detailed Syllabus:

Introduction – Need for proper management of land and water resources.

Planning of irrigation projects – Inadequacies in present approaches in canal irrigation management – command area development programmes.

Classification of irrigable soils – soils-plant-water relationships – soil management.

Irrigation management – Irrigation Management Matrix – Society and irrigation –perceptions of various stake holders on irrigation system performance.

Livelihood and Production Thinking Philosophy – the different approaches.

Macro and precision irrigation.

Water logging and salinity – water quality for irrigation – Reclamation of salt affected soils Participatory irrigation management – Farmer's management of irrigation system acts - conflict resolution.

Legal aspects in water sharing and management – PC-CP - case studies Introduction to Integrated Water Resources Management (IWRM).

Reading:

1. Asawa G.L, Irrigation Engineering, New Age Int., 2004.
2. Chambers R, Canal Management, Oxford IBH, 2002.
3. VVN Murthy (2003)," Land and Water Management Engineering", Kalyani Publishers.

4. Sharma RK and TK Sharma (2012), “Irrigation Engineering”, S Chand.

CE421	DESIGN OF HYDRAULIC STRUCTURES	DEC	3 – 0 – 0	3 Credits

Pre-requisites: Irrigation Engineering.

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

CO1	Analyse and design gravity dams
CO2	Analyse and design earth and rockfill dams
CO3	Design spillways and energy dissipation structures
CO4	Design of penstocks and surge tanks

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	-	-	-	3	-	-	-	1
CO2	-	-	-	3	-	-	-	1
CO3	-	-	-	3	-	-	-	1
CO4	-	-	-	3	-	-	-	1

Detailed Syllabus:

Introduction - Classification of dams, Gravity dams, Earth dams, Arch dam, Buttress dam, Steel dams, Timber dams, selection of site for dam, selection of type of dam, investigations of dam sites, Engineering surveys, Geological investigations, Types of hydropower plants, site selection for power plant, General arrangement of a hydropower project.

Principles of Design of Hydraulic Structures - Hydraulic structures on permeable foundations, Theories of subsurface floor, Khosla's method of independent variables, Exit gradient, Location of Hydraulic jump, water surface profiles, scour due to subsurface flow, Design Principles, Energy dissipation principles.

Gravity Dams - Types of storage head works, Forces acting on gravity dams, Analysis of gravity dams, Profile of a gravity dam, Finite Element Method, Design of gravity dam, joints in gravity dam, Galleries in gravity dam, Adits and shafts, Construction of gravity dam, Foundation Grouting, Instrumentation of gravity dams.

Earth dams - Types of earth dams, Causes of failure of earth dams, Seepage analysis, phreatic line, flow net construction, criteria for safe design of gravity dams, typical cross sections of earth dams, Stability analysis, Seepage control, design of filters.

Spillways and energy dissipation systems - Essential requirements of spillways, Required spillway capacity, component parts of spillway, Types of spillways, Design of Ogee spillway, Design of shaft spillway, Design of siphon spillway, Design of stilling basins. Hydropower structures - Storage power plant, Runoff River plant, Pumped storage plant, Water conveyance systems, Tunnels and Penstocks, Gates, Surge tanks, Power house layout.

Reading:

1. Golze, A. R., Handbook of Dam Engineering, Von Rostrand Reinhold Co., 1977
2. Sharma, H.D., Concrete Dams, CBIP Publication, 1998.
3. Siddiqui, I H, Dams and Reservoirs: Planning, Engineering, Oxford University Press, USA, 2009.

4. Novak, P., Moffat, A. I. B., Nalluri, C and Narayan, R., Hydraulic Structures, Taylor & Francis, 2006.
5. Modi P.M., Irrigation Water Resources and Hydropower Engineering, Standard Publishing Company, New Delhi, 2000.
6. Arora K.L. Irrigation Water Resources Engineering, Standard Book Publishing Co., Delhi, 1996.

CE422	SYSTEMS ANALYSIS IN CIVIL ENGINEERING	DEC	3 – 0 – 0	3 Credits

Pre-requisites: Mathematical Methods.

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

CO1	Formulate and solve deterministic optimization models
CO2	Apply deterministic optimization techniques for resource allocation, scheduling, inventory control, capacity expansion and transportation problems
CO3	Apply decision theory and stochastic optimization techniques for decision making under uncertainty
CO4	Formulate and solve optimization models for planning and design of civil engineering systems

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8

CO1	2	-	-	-	-	-	-	1
CO2	2	-	-	2	2	-	-	1
CO3	2	-	-	2	2	-	-	1
CO4	1	-	-	2	2	-	1	1

Detailed Syllabus:

Modeling Techniques: Concepts of Systems Engineering, Types of mathematical models, Formulation of a prescriptive model, Overview of optimization techniques, Linear Programming, Graphical method, Simplex method, Sensitivity analysis, Dual LP, Transportation problem, Assignment problem, Integer Linear Programming.

Dynamic Programming: Concepts of dynamic programming, Formulation of recursive equation, Resource allocation using DP, Capacity expansion, Inventory control.

Nonlinear Optimization: Classical optimization techniques, Lagrange methods, Kuhn-Tucker conditions, steepest gradient technique and other gradient based search techniques, Overview of genetic algorithm.

Decision Theory: Decision analysis, Decision making under risk and uncertainty, Markovian decision process, stochastic inventory control.

Simulation: Types of simulation models, Monte-Carlo simulation, Applications of simulation

Other Optimization Techniques.

Overview of Multi Objective Optimization Techniques, Fuzzy Optimization and Fuzzy Decision Making.

Reading:

1. Charles S. Revelle, E. Earl Whitlatch and Jeff R. Wright., Civil and Environmental Systems Engineering Pearson Education Inc., New Jersey, 2004.
2. Hiller, F. S. and Lieberman, G. J., Operations Research, CBS Publishers and Distributors, 2010.
3. Taha, H. A., Operations Research, Prentice Hall India, 2008.

CE423	MACHINE FOUNDATION	DEC	3 – 0 – 0	3 Credits

Pre-requisites: Engineering Geology and Geotechnical Engineering II.

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

CO1	Understand the dynamic behaviour of foundations.
CO2	Select foundation for dynamic loading
CO3	Design machine foundations
CO4	Identify vibration isolation techniques

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	2	-	-	-	-	-	-	1
CO2	1	-	-	-	-	-	-	1
CO3	1	-	-	3	-	-	-	2
CO4	-	-	-	-	2	-	-	1

Detailed Syllabus:

General Principles of Machine Foundation Design: Introduction, Types of Machines and Foundations, General requirements, Permissible Amplitude, Allowable soil pressure, Permissible stress of concrete and steel, Permissible stresses of Timber.

Foundations of Reciprocating Machines: Modes of vibration of a rigid foundation block, methods of analysis, linear elastic weightless spring methods, elastic half space method, effect of footing shape on vibratory response, dynamic response of embedded bock foundations, soil mass participating in vibrations, design procedure for a block foundation.

Foundations of impact machines: Introduction, Dynamic analysis; single degree freedom system, Multi degree freedom system, determination of initial velocity of hammer, stress in the pad, stresses in the soil, Design procedure for a hammer foundation.

Foundations of Rotary Machines: Introduction, special considerations, design criteria, loads on a turbo generator foundation, methods of analysis and design, resonance method, amplitude method, combined method, three dimensional analysis.

Vibration isolation and screening: Introduction, force isolation, motion isolation, screening of vibrations by use of open trenches, passive screening by use of pile barriers, problems.

Reading:

1. “Handbook of Machine Foundations” Srinivasulu, P. And Vaidyanathan, C. V., Tata McGraw-Hill, New Delhi, 2001
2. “Foundations for Machines, Analysis and Design” Prakash Shamsher and Puri Vijay K, John Wiley and Sons, USA, 1988.

CE424	FOUNDATION ANALYSIS AND DESIGN	DEC	3 – 0 – 0	3 Credits

Pre-requisites: Engineering Geology and Geotechnical Engineering - II.

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

CO1	Understand the behaviour of problematic soil
CO2	Design foundations on expansive soils
CO3	Analyse the lateral stability of piles and wells
CO4	Evaluate design parameters for dynamic loading

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	2	-	-	-	-	-	-	1
CO2	1	-	-	3	-	-	-	2
CO3	1	-	-	3	-	-	-	1
CO4	1	-	-	2	-	-	-	1

Detailed Syllabus:

Well foundations: Introduction – types and shapes of Caissons – Grip length, Estimation of bearing capacity and settlement of well foundation, Sinking of well foundation and remedial measures, Design of various elements/components of well foundation, Forces acting on well foundation, Lateral stability of well foundations by IRC method, Problems.

Pile foundations: Pile behavior under axial loads (piles under compression) – Review uplift capacity / resistance of piles (piles under tension), Lateral load capacity/ Resistance of piles, WINKLER'S hypothesis – Differential equations, BROM'S solution for laterally loaded vertical piles in sand and clay, IS Code method, Problems.

Combined Footings and Mat/Raft foundations: Computation of loads – Design steps – Proportioning of footings, Bearing capacity and settlement of Mat foundation, Types of rafts – Conventional methods of design (Rigid beam analysis), Beams on Elastic foundations, Problems.

Foundations on Expansive soils: Identification and characteristics of Expansive soils.

Free swell index and swell potential, Swell pressure – Factors –Test, Effect of swelling on building foundations, Fundamental design in expansive soil – CNS layer and other concepts, Under reamed pile and Drilled pier foundations, Problems.

Soil Exploration: Introduction – Methods of Soil Exploration, Exploratory borings in the field, Soil sampling – Rock coring, Field Tests, Subsurface exploration program – Preparation of borehole logs, Soil exploration report.

Reading:

1. Robert M. Koerner “Construction and Geotechnical methods in Foundation Engineering” McGraw-Hill Pub. Co., New York, 1985.
2. Das, BM (2009): Geotechnical engineering – Cengage learning, New Delhi.
3. Gopal Ranjan, Rao ASR (2000): Basic and applied soil mechanics – New age publication, Delhi.

CE425	GROUND IMPROVEMENT TECHNIQUES	DEC	3 – 0 – 0	3 Credits

Pre-requisites: Geotechnical Engineering – II and Engineering Geology.

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

CO1	Identify ground conditions and suggest method of improvement
CO2	Design and assess the degree of improvement
CO3	Understand the principles of soil reinforcement and confinement in engineering constructions
CO4	Design reinforced soil structures

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	1	2	-	-	1	-	-	1
CO2	1	-	-	2	2	-	-	1
CO3	2	-	-	2	2	-	-	1
CO4	-	-	-	3	2	-	-	1

Detailed syllabus

Introduction: Need and objectives of Ground Improvement, Classification of Ground Modification Techniques – suitability and feasibility.

Mechanical Modification: Principles of Mechanical Modifications - Methods of compaction, Shallow compaction, Deep compaction techniques – Vibro-floatation, Blasting, Dynamic consolidation, precompression and compaction piles.

Hydraulic Modification : Methods of dewatering – open sumps and ditches, Well-point system, Electro-osmosis, Vacuum dewatering wells; pre-loading with sand drains - strip drains, Design of vertical drains.

Physical and chemical modification: Stabilisation with admixtures like cement, lime, calcium chloride, fly ash and bitumen. Grouting – materials and methods.

Reinforced Earth Technology: Concept of soil reinforcement, Reinforcing materials, Backfill criteria, Design of reinforcement for internal stability, Applications of Reinforced earth structures.

Ground Anchors and Soil Nailing: Types of ground anchors and their suitability, Uplift capacity of anchors; Soil nailing and Applications.

Soil Confinement Systems: Concept of confinement, Gabion walls, Crib walls, Sand bags, Evergreen systems and fabric form work.

Geotextiles: Overview on Geosynthetics – Geotextiles, Functions and Applications.

Reading:

1. Manfred R. Haussmann - Engineering principles of ground modification – Pearson Education Inc. New Delhi, 2008.
2. Bell, F.G. – Engineering Treatment of Soils – E& FN Spon, New York, 2006.
3. Purushothama Raj, P “Ground Improvement Techniques” Laxmi Publications (P) Limited, 2006.

CE426	ROCK ENGINEERING AND UNDERGOUND STRUCTURES	DEC	3 – 0 – 0	3 Credits

Pre-requisites: Engineering Geology and Geotechnical Engineering - II.

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

CO1	Identify the problems associated with underground excavations
CO2	Classify the rock mass using the reference data
CO3	Understand the failure criteria of rock
CO4	Determine in-situ stresses from field test data

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	2	-	2	-	-	-	-

CO2	2	2	-	1	-	-	-	-
CO3	1	2	-	3	-	-	-	-
CO4	1	2	-	3	-	-	-	-

Detailed Syllabus:

Geological considerations; Geologic structures, faults, folds, joints, fissures

Index properties; Porosity, Density, Hydraulic Permeability and Conductivity, Strength, Slaking and Durability, Sonic Velocity.

Rock mass classifications; Rock Mass Rating (RMR), Rock Quality Designation (RQD), Joint orientation, Joint Testing, Joint Roughness, Insitu stresses in rocks and their measurement; Flat Jack Method

Strength and failure criteria for rocks and rock masses; Modes of Rock Failure, Deformation behaviour of rocks and rock masses, Time dependent behaviour of rocks

Application of rock mechanics to underground structures; Openings in Competent Rock, Horizontally Layered Rock, Rock with Inclined layers, Plastic behaviour around Tunnels, Ground response support methods

Slopes and foundations; Modes of failure of slopes in Hard rock, Kinematic analysis of slopes, Analysis of plane slides, Rock excavation, Improving the properties of insitu rock masses

Reading:

1. Brady B.H.G. and Brown E.T. Rock Mechanics for Underground Mining, Kluwer Academic Publishers, 2005
2. Goodman R.E., Introduction to Rock Mechanics, John Wiley and Sons, New York, 1989.
3. Ramamurthy T., Engineering in Rocks for Slopes, Foundations and Tunnels, PHI Learning Pvt. Ltd. 2010.

CE427	REMOTE SENSING	DEC	3 – 0 – 0	3 Credits

Pre-requisites: Physics, Surveying, Engineering Geology and Engineering Hydrology.

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

CO1	Retrieve the information content of remotely sensed data
CO2	Analyse the energy interactions in the atmosphere and earth surface features
CO3	Interpret the images for preparation of thematic maps
CO4	Apply problem specific remote sensing data for civil engineering applications

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	2	1	2	1	1	-	-
CO2	2	2	3	3	2	1	-	-
CO3	1	1	3	3	1	-	-	-
CO4	2	3	1	-	1	-	-	-

Detailed Syllabus:

Fundamentals of Aerial Photogrammetry: Introduction, Classification, Aerial Camera, Films and Filters, Geometrical elements of vertical photograph, Scale, Relief Displacements, photo and ground coordinates, flight planning.

Stereoscopy: Stereoscopic vision, Lens and Mirror stereoscope, parallax equations, Parallax bar, Measurement of heights and heights and slopes, Ground control for aerial Photography, Topo sheets, Photographs and Mosaics.

Aerial Photo Interpretation: Basic considerations, principles of photo interpretation, Characteristics of photographic images, Techniques of photo interpretation, photo interpretation key, Ground truth verification.

Principles of Remote Sensing: Sources of Energy, active and passive radiation, Electromagnetic spectrum, radiation laws, interaction of energy with atmosphere scattering, absorption, atmospheric windows, interaction of EMR with earth surface features- spectral signatures, stages in remote sensing.

Sensors and Platforms: Characteristics of space platforms and sensors, LANDSAT, SPOT, NOAA and IRS Series.

Fundamentals of Satellite Image Interpretation: Types of data products, visual interpretation techniques, basic concepts of digital image processing techniques.

Remote Sensing Applications in Civil Engineering - Water Resources, Watershed Management, Environmental studies, Land use and Land Cover mapping – Urban sprawl and Transportation Network mapping, Geology and soil mapping, Ground Water Exploration.

Reading:

1. Floyd F. Sabins, Remote Sensing Principles and Interpretation, W.H. Freeman and Co. 2007.
2. Lillisand T.M and Kiefer R.W, Remote Sensing and Image Interpretation, John Wiley and Sons, 2008.
3. Paul R. Wolf: Elements of Photogrammetry, with Air Photo Interpretation and Remote Sensing, McGraw Hill International Book Company, 2000.

CE428	ADVANCED SURVEYING	DEC	3 – 0 – 0	3 Credits

Pre-requisites: Surveying.

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

CO1	Understand the basic principles of astronomical survey
CO2	Identify and correct errors in field measurements
CO3	Understand procedures of triangulation

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	1	-	1	-	-	-	-
CO2	2	1	-	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-

Detailed Syllabus:

Astronomical Surveying: Astronomical coordinate systems, astronomical triangle, determination of azimuth.

Construction and Boundary Surveys: Equipment for construction surveys, Setting out pipe line, setting out buildings and structures, setting out a highway,

Theory of Errors: Types and sources of errors, theory of least squares, method of weights, method of correlates, angle and station adjustment, figure adjustment.

Land Surveys: Layouts, Measurements.

Triangulation and Baseline Measurements: Triangulation figures or systems, station marks, signals, towers, Baseline measurement by rigid bars, flexible apparatus, problems, satellite station and reduction to centre.

Total Station and GPS: Basic principles, classifications, applications, comparison with conventional surveying. Electromagnetic wave theory - electromagnetic distance measuring system - principle of working and EDM instruments, Components of GPS – space segment, control segment and user segment, reference systems, satellite orbits, GPS observations. Applications of GPS.

Reading:

1. Borden D. Dent, Jeffrey Troguson, Thomas W. Hodler, Cartography: Thematic Map Design, McGraw-Hill Higher Education, 2008.

2. Gopi, Advanced Surveying: Total Station, GIS and Remote Sensing, Pearson Education India, 2007.
3. Hoffman.B, H.Lichtenegga and J.Collins, Global Positioning System - Theory and Practice, Springer -Verlag Publishers, 2001.
4. Punmia B. C, Ashok K. Jain, Arun K. Jain, Higher Surveying, Laxmi Publications, 2005.

CE429	PAVEMENT ENGINEERING	DEC	3 – 0 – 0	3 Credits

Pre-requisites: Geotechnical Engineering - I, Engineering Geology and Transportation Engineering.

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

CO1	Characterize the response characteristics of soil, aggregate, asphalt, and asphalt mixes
CO2	Analyze flexible pavements
CO3	Analyze rigid pavements
CO4	Design a flexible pavement using IRC, Asphalt Institute, and AASHTO methods
CO5	Design a rigid pavement using IRC, and AASHTO methods

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	-	-	3	-	-	-	-	-
CO2	3	-	-	3	-	-	-	-
CO3	3	-	-	3	-	-	-	-
CO4	3	-	-	3	-	-	-	-
CO5	3	-	-	3	-	-	-	-

Detailed Syllabus:

Pavement Materials : Types and component parts of pavements, highway and airport pavements, Materials used in pavements, basic soil properties relevant to pavement applications, resilient modulus, and modulus of sub-grade reaction, Physical properties of aggregates and blending, Basic properties of bitumen, polymer and rubber modified bitumen, Dynamic modulus, flow time and flow number of bituminous mixes. Cement: chemical composition, types, physical properties. Distresses in flexible and rigid pavements. Use of geosynthetics in pavements.

Stresses in Pavements: Stresses in flexible pavements: layered system concepts, stress solution for one, two and three layered systems, fundamental design concepts.

Stresses in rigid pavements: Westergaard's theory and assumptions, stresses due to curling, stresses and deflections due to loading, frictional stresses, stresses in dowel bars and tie bars.

Factors Affecting Pavement Design: Variables considered in pavement design, Classification of axle types, articulated commercial vehicles, legal axle and gross weights on single and multiple units, tyre pressure, contact pressure, ESWL, EWLF and EAL concepts, Traffic analysis: ADT, AADT, growth factor, lane distribution, directional distribution and vehicle damage factors.

Design of Pavements: IRC method of flexible pavement design, Design of flexible pavements for low volume roads using IRC method, IRC methods of rigid pavement design, Design of rigid pavements for low volume roads using IRC method.

Reading:

1. Huang, Y.H. Pavement Analysis and Design, Second Edition, Dorling Kindersley (India) Pvt. Ltd., New Delhi, India, 2008.
2. IRC: 37-2012 Guidelines for the Design of Flexible Pavements, The Indian Roads Congress, New Delhi, India, 2012.
3. IRC: 58-2011 Guidelines for the Design of Plain Jointed Rigid Pavements for Highways, The Indian Roads Congress, New Delhi, India, 2011.
4. IRC: SP: 62-2004 Guidelines for the Design and Construction of Cement Concrete Pavements for Rural Roads, The Indian Roads Congress, New Delhi, India, 2004.
5. IRC: SP: 72-2007 Guidelines for the Design of Flexible Pavements for Low Volume Rural Roads, The Indian Roads Congress, New Delhi, India, 2007.
6. Mallick, R.B. and T. El-Korchi Pavement Engineering – Principles and Practice, CRC Press, Taylor and Francis Group, Florida, USA, 2009.
7. Ministry of Road Transport and Highways. Specifications for Road and Bridge Works, Fifth Edition, Indian Roads Congress, New Delhi, India, 2013.
8. Papagiannakis, A.T. and E.A. Masad Pavement Design and Materials, John Wiley and Sons, New Jersey, USA, 2008.
9. Yoder, E.J. and M.W. Witczak Principles of Pavement Design, Second Edition, John Wiley and Sons, New York, USA, 1975.

CE430	**LOW VOLUME ROADS**	**DEC**	**3 – 0 – 0**	**3 Credits**

Pre-requisites: Transportation Engineering**.**

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

CO1	Plan rural road network
CO2	Design highway geometrics

CO3	Justify the geometric design standards adopted for low volume roads
CO4	Plan surveys, and prepare survey forms
CO5	Understand the procedure for conducting safety audit
CO6	Design pavements for low volume roads

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	-	3	-	-	-	3	-	-
CO2	-	-	-	3	-	-	-	-
CO3	-	-	-	3	-	-	-	-
CO4	-	3	-	-	-	-	-	-
CO5	-	-	-	-	3	-	-	-
CO6	-	-	-	3	-	-	-	-

Detailed Syllabus:

Planning And Alignment - Classification, Introduction and Importance about Rural Roads, Planning of low volume Roads and Concept of Network Planning, Road Alignment, Surveys and Factors for Route Selection.

Geometric Design Standards - Basic Principles of Geometric Design, Standards for Various Geometric Components.

Road Materials and Pavement Design - Soils, Sub grade, Stabilized Soils, Road Aggregates, and Binding Materials. Pavement Design Parameters, Pavement Components, Design of Flexible Pavement, gravel Roads, Design of Rigid, Semi Rigid Pavements, and Shoulders.

Drainage Design - Hydrology for Drainage, Hydraulic Design – culverts, Drainage – surface and subsurface.

Construction and Specifications - Selection of Material and Methodology for Embankment, Sub grade, Sub base & base Courses, Bituminous Constructions, Semi Rigid Pavement Construction, Equipment Required for Different Operations.

Quality Control and Maintenance - Quality Control in Low Volume Road Construction, Maintenance Activities, types of Maintenance.

Use of Waste Materials - Various Types of Waste Material and their Significance and Usage, Recycled Concrete Aggregates.

Reading:

1. IRC codes for Rural Road Manual, Flexible and Rigid Pavement Design, Gravel Roads and Block Pavement Design codes.
2. Yang H. Huang, Pavement Analysis & Design, Prentice Hall Inc., 2nd Edition, 2003.

3. Mallick & El-Korch, Pavement Engineering: Principles and Practice, CRC Press, 2009.
4. PIARC, International Road Maintenance Hand Book –Maintenance of Paved/unpaved Roads, France.
5. Nicholas Thom, Principles of Pavement Engineering, ICE Publishing, 2008.
6. George Richard Chatburn, Highway Engineering; Rural Roads and Pavements, Rarebooksclub, 2012.

CE431	RAILWAY ENGINEERING	DEC	3 – 0 – 0	3 Credits

Pre-requisites: Transportation Engineering**.**

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

CO1	Understand the importance of railway infrastructure planning and design
CO2	Identify the factors governing design of railway infrastructures
CO3	Design and analyze the railway track system
CO4	Understand the process of execution of railway projects

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	-	1	-	1	-	-	-	-
CO2	-	3	-	1	-	-	-	-
CO3	-	-	-	3	-	-	-	-

CO4	-	-	-	-	3	-	-	-

Detailed Syllabus:

Introduction to Railways in India: Role of Indian Railways in National Development – Railways for Urban Transportation –LRT & MRTS.

Alignment of Railway Lines: Engineering Surveys for Track Alignment – Obligatory points - Conventional and Modern methods (Remote Sensing, GIS & GPS, EDM and other equipments).

Permanent Way: Components and their Functions: Rails - Types of Rails, Rail Fastenings, Concept of Gauges, Coning of Wheels, Creeps and kinks Sleepers – Functions, Materials, Density – Functions, Materials, Ballast less Tracks.

Geometric Design of Railway Tracks: Gradients and Grade Compensation, Super-Elevation, Widening of Gauges in Curves, Transition Curves, Horizontal/Vertical Curves.

Track maintenance and Rehabilitation: Points and Crossings - Design of Turnouts, Working Principles, Automated maintenance and upgrading.

Railway accidents: Human and system contribution to catastrophic accidents, Human Factors in Transport Safety, Unprotected level crossings, Safety Audit.

Rolling Stock, Railway sections and yards: Re-laying of Track, Lay outs of Railway Stations and Yards, Rolling Stock, Tractive Power, Track Resistance, Level Crossings.

Signalling and Interlocking: Signalling, Interlocking and Track Circuiting - Construction & Maintenance.

Design of tracks for high speeds: Geometrical requirements, Challenges, Ballasted or Ballast less, Design methodology, Structural model, Dynamics analysis, Maintenance considerations.

Reading:

1. Chandra S. and M.M. Agarwal, Railway Engineering, Oxford University Press, New Delhi, India, 2007.
2. Saxena, S.C. and S.P. Arora, Railway Engineering, Dhanpat Rai and Sons, New Delhi, India, 1997.
3. Agarwal, M.M., Indian Railway Track, Prabha and Co., New Delhi, India, 1988.
4. Rangwala, S.C., Principles of Railway Engineering, Charotar Publishing House, Anand, India, 1988.

CE432	TRAFFIC ENGINEERING	DEC	3 – 0 – 0	3 Credits

Pre-requisites: Transportation Engineering**.**

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

CO1	Estimate basic characteristics of traffic stream
CO2	Conduct traffic studies and analyze traffic data
CO3	Design traffic signal systems
CO4	Determine the capacity of highways

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	-	3	-	-	-	-	-	-
CO2	-	3	-	-	-	-	-	-
CO3	-	-	-	3	-	-	-	-
CO4	-	-	-	3	-	-	-	-

Detailed Syllabus:

Components of traffic system: Introduction, Human-vehicle-environment system, Characteristics of road users, highways and vehicles, Fundamental parameters of traffic and relationship.

Traffic characteristics: Microscopic and macroscopic flow characteristics, Time headways, temporal, spatial and flow patterns, Interrupted and un-interrupted traffic, Microscopic and macroscopic speed characteristics, Vehicular speed trajectories, Speed characteristics-mathematical distributions Speed and travel time variations; travel time and delay studies, distance headway characteristics, Car-following and lane change theories, Flow and density measurement techniques, illustrated examples.

Traffic Stream Models: Traffic flow modelling analogies, Macroscopic flow models, Microscopic flow models, Mesoscopic models, Shockwave analysis with examples Capacity and level of service analysis.

Highway capacity and Level of service, Factors affecting, capacity analysis and LOS criteria, case studies on capacity and level of service estimation.

Traffic Signal Design: Introduction about the signal and warrants, Signal phasing and development of phase plans; Cycle length, fixed and vehicle actuated signals, Webster method; Drew method; IRC method, Signal coordination, Area traffic control system, problems on signal design.

Design of at-grade Intersections: Types of intersections, Plain intersections, rotary and Mini Roundabout: Design aspects.

Accident Analysis: Accident characteristics – road – driver – vehicle, Accident recording and analysis, Highway safety improvement program, Safety audit.

Parking System Analysis: Parking Inventory Studies, Parking Statistics, On-street and Off-street parking facilities, Worked out examples.

Intelligent Transportation Systems: Components of ITS, Traffic Management - Incident Management, Advanced vehicle control and safety systems, Electronic toll collection, Traveller Information System, Benefits and costs of ITS**.**

Reading:

1. L.R. Kadiyali, Traffic Engineering and Transportation Planning, Khanna Publishers, 2011.
2. Roger P. Roess, Elena S. Prassas and William R. McShane, Traffic Engineering, Prentice Hall, 4th edition, 2010.
3. May, A.D. Traffic Flow Fundamentals, Prentice Hall, 1st Edition, 1989.
4. Fred L. Mannering, Scott S. Washburn, Kilareski Walter P., Principles Of Highway Engineering And Traffic Analysis, Wiley India Pvt Ltd., 4th edition, 2011.
5. Mike Slinn, Paul Matthews, Peter Guest, Traffic Engineering Design: Principles and Practice.
6. Butterworth-heinemann, 2nd Edition, 2005.
7. Bob Williams, Intelligent Transport Systems Standards, Artech House Publishers, 2008.

CE461	**DESIGN OF EARTHQUAKE RESISTANT STRUCTURES**	**DEC**	**3 – 0 – 0**	**3 Credits**

Pre-requisites: Theory of Structures-II.

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

CO1	Apply seismic coefficient and response spectrum methods for analysis of multi storied buildings
CO2	Apply concepts of ductility in the design of multi-storeyed structures
CO3	Analyse a water tank structure based on latest earthquake code
CO4	Understand the concepts of base isolation

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	2	2	-	2	-	-	1	1
CO2	2	2	-	2	-	-	1	1
CO3	1	2	1	2	-	-	-	1
CO4	-	2	1	-	-	-	1	1

Detailed Syllabus:

Elements of Earthquake Engineering: Earthquake magnitude and intensity, Focus and Epicentre, Causes and Effects of Earthquakes, Characteristics of Earthquake, Seismic zone mapping.

Structural Systems For Seismic Resistance: Structural systems – building configuration, frames, walls, dual systems – response in elevation – plan – influence of structural classification- Concepts of seismic design.

Analysis for Earth Quake Loads: IS: 1893-2002- Seismic Coefficient method- modal analysis- Applications to multi-storied building frames – water tanks – chimneys.

Ductile Detailing: Ductility of R.C structures- Confinement- detailing as per IS-13920-1993- moment redistribution – principles of design of beams, columns – beam column joints – soft story concept.

Base Isolation: Isolation systems – Effectiveness of base isolation.

Reading:

1. Dynamics of structures – A.K. Chopra, Prentice Hall.
2. I.S. 1893 - 2002, Criteria for Earthquake Resistance design of Structures.
3. Pankaj Agarwal and Manish Shrikhande, Earthquake resistant design of structures, PHI 2006.

CE462	ADVANCED REINFORCED CONCRETE DESIGN	DEC	3 – 0 – 0	3 Credits

Pre-requisites: Design of Concrete Structures.

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

CO1	Design cantilever and counterfort retaining walls
CO2	Design underground and elevated water tanks
CO3	Design bunkers and silos

CO4	Design reinforced concrete chimneys

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	2	2	-	2	-	-	1	1
CO2	2	2	-	2	-	-	1	1
CO3	1	2	1	2	-	-	-	1
CO4	-	2	1	-	-	-	1	1

Detailed Syllabus:

Principles of Cantilever and counterfort type retaining walls, Detailed design of cantilever type of retaining walls only, Detailed Design of Grid Floors, Analysis and Design of Flat Slabs, Design principles of underground and elevated water tanks, Detailed design of rectangular and circular elevated water tanks as per IS 3370, Design of Ring Beam and staging for elevated water tanks, Detailed Design of Intz Tanks, R.C. Bunkers and Chimneys.

Reading:

1. N. Krishna Raju, Advanced Reinforced Concrete Design, CBS Publishers and Distributors, 2007.
2. Punmia B.C. Ashok Kumar Jain and Arun K. Jain, RCC Designs(Reinforced Concrete Design), 10th Edition, Lakshmi Publishers, 2006

CE463	**REPAIR AND REHABILITATION OF STRUCTURES**	**DEC**	**3 – 0 – 0**	**3 Credits**

Pre-requisites: Design of Concrete Structures.

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

CO1	Assess strength and materials deficiency in concrete structures
CO2	Suggest methods and techniques used in repairing / strengthening existing concrete structures
CO3	Apply Non Destructive Testing techniques to field problems
CO4	Apply cost effective retrofitting strategies for repairs in buildings

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	1	2	2	-	1	-	-	1
CO2	-	-	-	1	2	-	-	1
CO3	-	2	-	-	2	-	-	1
CO4	-	-	-	2	2	-	1	1

Detailed Syllabus:

Aging of structures – performance of structures – need for rehabilitation.

Distress in concrete / steel structures – damage – source – cause – effects – case studies.

Damage assessment and Evaluation models – Damage testing methods – NDT – Core samples.

Rehabilitation methods – grouting – detailing – imbalance of structural stability – case studies.

Methods of repairs – shortcreting – guniting – epoxy – cement mortar injection – crack ceiling.

Repair and maintenance of buildings – IS standards – Bridge repairs – Seismic strengthening.

Reading:

1. Diagnosis and treatment of Structures in Distress – R N Raikar.
2. Bridge Rehabilitation – V K Raina.
3. Building Failures – Diagnosis and Avoidance – W H Ranson.
4. Forensic Engineering – Kennethe and Carper.

CE464	**FINITE ELEMENT ANALYSIS**	**DEC**	**3 – 0 – 0**	**3 Credits**

Pre-requisites: Mathematical Methods.

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

CO1	Develop shape functions and stiffness matrices for spring and bar elements
CO2	Develop global stiffness matrices and global load vectors
CO3	Apply natural and arial coordinate systems to constant strain triangle and linear strain triangle elements
CO4	Analyze planar structural systems using finite element modelling

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	2	-	-	1	-	-	-	1
CO2	2	-	-	1	-	-	-	1

CO3	2	-	-	2	-	-	-	1
CO4	-	-	-	3	-	-	-	1

Detailed Syllabus:

Matrix Methods of Structural Analysis – Review of concepts – Actions and displacements – compatibility – indeterminacy – Member and joint loads – Flexibility Matrix formulation - Stiffness Matrix formulation.

Introduction to Finite Element Method – Background and general description of the method – summary of the analysis procedure.

Theory of Finite element method – Concept of element – various element shapes – displacement models – shape functions – isoparametric elements – formulation of element stiffness and loads – condensation of internal degrees of freedom.

Overall problem – Assemblage of elements construction of stiffness matrix and loads – boundary conditions and solution of overall problem – Application to continuous beam – spring assemblage – stability of columns – curved beams and vibration problems - torsions of shafts.

Generalization of FEM – Six step finite element procedure in general terms – application to structural engineering problems – analysis of plates, shells and frames.

Reading:

1. Finite element analysis, theory and Programming by CS Krishna Murthy.
2. Introduction to Finite element Method by Tirupathi chandra Patla and Belugundu.
3. Textbook of Finite Element Analysis, 1st Edition, PHI, 2009.

CE465	ENVIRONMENTAL MODELLING	DEC	3 – 0 – 0	3 Credits

Pre-requisites: Mathematical Methods**.**

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

CO1	Understand and apply the concepts of mass balance in various engineered systems
CO2	Assess pollutant transport using mass transport equations
CO3	Calculate the size of the Kolmogorov micro scale in sheared reactors
CO4	Estimate the fractal dimension of flocs in coagulation process and estimate the bulk density of the flocs based on the fractal dimension

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	2	-	-	-	-	1	-	1
CO2	-	-	-	-	-	2	1	1
CO3	-	-	-	2	-	2	1	1

CO4	-	-	-	2	-	2	1	1

Detailed Syllabus:

Basic concepts of mole and mass concentration: notations and conventions, Review of mass balance concepts.

Diffusive transport: Diffusion and Fick's first law, Calculation of molecular diffusion coefficients in air and water.

The constitutive transport equation: Derivation of general transport equation and special forms i.e. continuity and NS equations and similarity between equations of mass momentum and heat dispersion laws.

Theories of mass transport: two film theory, penetration and surface renewal theory, Boundary layer theory. Mass transport correlations.

Transport in sheared reactors: Fluid shear and turbulence, transport in steady sheared fluids, turbulent sheared fluids, and shear rates in mixed reactors.

Particles and fractals: Introductions, particle size spectra, solid particles and fractal aggregate geometries, measuring and calculating fractal dimensions from particle size distributions.

Coagulation in natural and engineered systems: Introduction, general coagulation equations, factors affecting the stability of aquasols, coagulation kinetics, fractal coagulation models.

Reading:

1. Environmental Transport Processes by Bruce E. Logan, 2nd Ed., Wiley, 2012.
2. Diffusion: Mass transfer in fluid systems by E.L. Cussler, 3rd Ed., Cambridge University Press, 2007.
3. Introduction to chemical transport in the environment by John S. Gulliver, Cambridge University Press, 2007.
4. Environmental Engineering: A Design Approach by Sincero and Gregoria, PHI Learning, 2009.

CE466	ENVIRONMENTAL IMPACT ANALYSIS	DEC	3 – 0 – 0	3 Credits

Pre-requisites: Environmental Studies.

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

CO1	Identify the environmental attributes to be considered for the EIA study
CO2	Formulate objectives of the EIA studies
CO3	Identify the methodology to prepare rapid EIA
CO4	Prepare EIA reports and environmental management plans

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	-	2	-	-	-	2		1
CO2	-	-	-	-	2	2	1	1
CO3	-	-	-	-	2	1	1	1
CO4	-	-	-	-	2	2	2	1

Detailed Syllabus:

Introduction: The Need for EIA, Indian Policies Requiring EIA, The EIA Cycle and Procedures, Screening, Scoping, Baseline Data, Impact Prediction, Assessment of Alternatives, Delineation of Mitigation Measure and EIA Report, Public Hearing, Decision Making, Monitoring the Clearance Conditions, Components of EIA, Roles in the EIA Process. Government of India Ministry of Environment and Forest Notification (2000), List of projects requiring Environmental clearance, Application form, Composition of Expert Committee, Ecological sensitive places, International agreements.

Identifying the Key Issues: Key Elements of an Initial Project Description and Scoping, Project Location(s), Land Use Impacts, Consideration of Alternatives, Process selection - Construction Phase, Input Requirements, Wastes and Emissions, Air Emissions, Liquid Effluents, Solid

Wastes, Risks to Environment and Human, Health, Socio-Economic Impacts, Ecological Impacts, Global Environmental Issues.

EIA Methodologies: Criteria for the selection of EIA methodology, impact identification, impact measurement, impact interpretation & Evaluation, impact communication, Methods-Adhoc methods, Checklists methods, Matrices methods, Networks methods, Overlays methods, Environmental index using factor analysis, Cost/benefit analysis, Predictive or Simulation methods. Rapid assessment of Pollution sources method, predictive models for impact assessment, Applications for RS and GIS.

Reviewing the EIA Report: Scope, Baseline Conditions, Site and Process alternatives, Public hearing, Construction Stage Impacts, Project Resource Requirements and Related Impacts, Prediction of Environmental Media Quality, Socio-economic Impacts, Ecological Impacts, Occupational Health Impact, Major Hazard/ Risk Assessment, Impact on Transport System,Integrated Impact Assessment.

Review of EMP and Monitoring: Environmental Management Plan, Identification of Significant or Unacceptable Impacts Requiring Mitigation, Mitigation Plans and Relief & Rehabilitation, Stipulating the Conditions, What should be monitored? Monitoring Methods, Who should monitor? Pre-Appraisal and Appraisal.

Case Studies: Preparation of EIA for developmental projects- Factors to be considered in making assessment decisions, Water Resources Project, Pharmaceutical industry, thermal plant, Nuclear fuel complex, Highway project, Sewage treatment plant, Municipal Solid waste processing plant, Tannery industry.

Reading:

1. Jain, R.K., Urban, L.V., Stracy, G.S., Environmental Impact Analysis, Van Nostrand Reinhold Co., New York, 1991.
2. Barthwal, R. R., Environmental Impact Assessment, New Age International Publishers, 2002
3. Rau, J.G. and Wooten, D.C., Environmental Impact Assessment, McGraw Hill Pub. Co., New York, 1996.
4. Anjaneyulu. Y and Manickam. V., Environmental Impact Assessment Methodologies, B.S. Publications, Hyderabad, 2007.
5. Wathern. P Environmental Impact Assessment- Theory and Practice, Routledge Publishers, London, 2004.

CE467	WATER RESOURCES SYSTEMS	DEC	3 – 0 – 0	3 Credits

Pre-requisites: Mathematical Methods, Engineering Economics and Accountancy.

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

CO1	Identify the characteristics and objectives of water resources systems
CO2	Perform basic economic analysis to evaluate the economic feasibility of water resources projects
CO3	Formulate and solve deterministic optimization models for design and operation of water resources systems
CO4	Formulate and solve stochastic and fuzzy optimization problems for decision making under uncertainty

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	2	-	-	-	-	2	-	1
CO2	-	-	-	-	2	1	2	1
CO3	-	-	-	2	2	-	1	1
CO4	-	-	-	2	2	-	1	1

Detailed Syllabus:

Introduction, Water Resources Planning, concepts of systems approach in planning, objectives of water resources development.

Characteristics of water resources systems.

Economic analysis, discounting techniques, benefit cost evaluation.

Optimal water allocation for water supply, irrigation, and hydropower.

Determination of capacity of a reservoir capacity for conservation, sequent peak method, linear programming model, determination of reservoir capacity for flood control.

Optimal operation of a reservoir, deterministic dynamic programming, and chance constrained linear programming model and stochastic dynamic programming model.

Planning of an irrigation system, optimal cropping pattern.

Irrigation scheduling.

Water quality management in a river basin and groundwater basin.

Reading:

1. Charles S. Revelle, E. Earl Whitlatch and Jeff R. Wright, Civil and Environmental Systems Engineering, Pearson Education Inc., New Jersey, 2004.
2. Loucks, D.P. and Eelco van Beek, Water Resources Systems Planning and Management – An introduction to methods, models and applications, Studies and Reports in Hydrology, UNESCO Publishing, 2005.
3. Vedula. S., and Mujumdar, P.P, Water Resources Systems-Modelling Techniques and Analysis, 2005.

CE468	GROUNDWATER DEVELOPMENT	DEC	3 – 0 – 0	3 Credits

Pre-requisites: Engineering Geology and Engineering Hydrology.

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

CO1	Evaluate groundwater resources using geophysical methods
CO2	Estimate aquifer parameters
CO3	Model regional groundwater flow and design water wells
CO4	Design water wells

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	1	2	-	-	-	2	1	1
CO2	-	-	-	2	-	2	1	1
CO3	-	-	-	2	2	-	1	1
CO4	-	-	-	2	-	-	1	

Detailed Syllabus:

Types of aquifers, confined and un-confined aquifers, leaky – aquifers.

Geo-physical exploration studies.

Different types and procedures for analysis of geophysical studies

Well hydraulics, partial differential equations governing.

Groundwater flow in aquifers, estimation of aquifer parameters by different methods.

Steady groundwater flow analysis for multiwall systems, method of images.

Water well design, Well construction and maintenance procedures.

Reading:

1. Garg S.P. Groundwater and Tube Wells, Oxford and IBH Publishing Co. New Delhi, 2002.
2. Raghunath H.M., 2002.Groundwater, New Age International Pub., New Delhi.
3. Todd, D.K., and Mays, L. W., Groundwater Hydrology, John Wiley & Sons, Singapore, 2011.

CE469	**HYDROPOWER ENGINEERING**	**DEC**	**3 – 0 – 0**	**3 Credits**

Pre-requisites: Fluid Mechanics - II.

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

CO1	Estimate hydropower potential
CO2	Identify types of hydropower plants
CO3	Design penstocks and surge shaft
CO4	Plan the layout of a hydropower plant

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	-	-	-	-	-	2	-	-

CO2	-	-	-	1	-	-	-	-
CO3	-	-	-	3	2	-	-	1
CO4	-	2	-	2	-	-	1	-

Detailed Syllabus:

Stream flow analysis, Hydrograph, Mass curve, Runoff estimation methods, estimation of hydropower potential, flow duration curves, power duration curves, pondage and storage.

Electrical load on hydro turbines, load curves, load duration curves, Performance factors.

Types of hydropower plants, Storage power plant, Runoff River plant, Pumped storage plant, two units and three unit arrangements, Reversible pump turbines, types of turbines, hydraulics of turbines, cavitation in turbine, efficiency of pumped storage plants.

Intakes, losses in intakes, air entrainment at intake, inlet aeration, Water conveyance systems, fore bay, canals, Tunnels and Penstocks, classification of penstocks, design criteria of penstock, economical diameter of penstock, Anchor blocks, Conduit valves, types of valves, bends and manifolds.

Water hammer, resonance in penstocks, channel surges, Gates, Surge tanks, Power house layout, lighting and ventilation, variations in design of power house, underground power house, structural design of power house.

Reading:

1. Arora, K.R., Irrigation Water Power and Water Resources Engineering, Standard Book Company, Delhi, 2002
2. Dandekar, M.M., and Sharma, K.N., Water Power Engineering, Vikas Publishing Company, New Delhi, 2003
3. Garg, S.K., Irrigation Engineering and Hydraulic Structures, Khanna Publishers, 2009
4. Jog, M.G., Hydroelectric and Pumped Storage Plants, Wiley Eatern Ltd., New York, 1989.

CE470	**WATERSHED MANAGEMENT**	**DEC**	**3 – 0 – 0**	**3 Credits**

Pre-requisites: Engineering Hydrology**.**

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

CO1	Identify the causes of soil erosion
CO2	Plan and design soil conservation measures in a watershed
CO3	Plan and design water harvesting and groundwater recharging structures
CO4	Plan measures for reclamation of saline soils

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	2	-	-	-	1	1	-	-
CO2	-	-	-	2	3	-	1	1
CO3	-	-	-	2	3	-	1	1
CO4	-	-	-	2	3	-	1	1

Detailed Syllabus:

Introduction, concept of watershed, need for watershed management, concept of sustainable development.

Hydrology of .small watersheds.

Principles of soil erosion, causes of soil erosion, types of soil erosion, estimation of soil erosion from small watersheds.

Control of soil erosion, methods of soil conservation – structural and non-structural measures.

Principles of water harvesting, methods of rainwater harvesting, design of rainwater harvesting structures.

Artificial recharge of groundwater in small watersheds, methods of artificial recharge.

Reclamation of saline soils.

Micro farming, biomass management on the farm.

Reading:

1. Chatterjee, S. N., Water Resources Conservation and Management, Atlantic Publishers, 2008.
2. Murthy, V.V.N., Land and Water Management, Khalyani Publishers, 2004.
3. Muthy, J. V. S., Watershed Management, New Age International Publishers, 1998.
4. Suresh Rao, Soil and Water Conservation Practices, Standard Publishers, 1998.

CE471	SOLID WASTE MANAGEMENT	DEC	3 – 0 – 0	3 Credits

Pre-requisites: Environmental Engineering.

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

CO1	Identify the physical and chemical composition of wastes
CO2	Analyze the functional elements for solid waste management.
CO3	Understand the techniques and methods used in transformation, conservation, and recovery of materials from solid wastes.
CO4	Identify and design waste containment systems

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	1	-	2	-	-	-	1	
CO2	-	-	-	2	2	-	1	1

CO3	-	-	-		2	-	1	1
CO4	-	-	-	3	2	-	1	1

Detailed Syllabus:

Solid Waste: Definitions, Characteristics, and Perspectives; Types of solid wastes, sources of solid wastes, properties of solid wastes, solid waste management: an overview.

Engineering Systems for Solid Waste Management: Solid waste generation; on-site handling, storage and processing; collection of solid wastes; transfer and transport; processing techniques; ultimate disposal.

Engineering Systems for Resource and Energy Recovery: Processing techniques; materials-recovery systems; recovery of biological conversion products; recovery of thermal conversion products; recovery of energy from conversion products; materials and energy recovery systems.

Reading:

1. Tchobanoglous G, Theisen H and Vigil SA 'Integrated Solid Waste Management, Engineering Principles and Management Issues' McGraw-Hill, 1993.
2. Vesilind PA, Worrell W and Reinhart D, 'Solid Waste Engineering' Brooks/Cole Thomson Learning Inc., 2002.
3. Peavy, H.S, Rowe, D.R., and G. Tchobanoglous, 'Environmental Engineering', McGraw Hill Inc., New York, 1985.
4. Qian X, Koerner RM and Gray DH, 'Geotechnical Aspects of Landfill Design and Construction' Prentice Hall, 2002.

CE472	**ENVIRONMENTAL GEOTECHNICAL ENGINEERING**	**DEC**	**3 – 0 – 0**	**3 Credits**

Pre-requisites: Geotechnical Engineering - I and Environmental Engineering.

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

CO1	Understand composition, soil structure and its behavior
CO2	Identify contaminant transport mechanisms in soils
CO3	Specify site investigation techniques for characterization of contaminated site
CO4	Understand the principles of soil treatment techniques

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	1	-	1	-	1	-	-	-
CO2	2	-	-	-	-	2	1	1

CO3	-	2	-	-	2	-	1	1
CO4	-	-	-	-	2	-	1	1

Detailed Syllabus:

Introduction: Soil-the three-phase system, Clay - the most active soil fraction, Clay-water interactions, Causes of soil deterioration, Scope and importance of environmental geotechniques.

Ground Contamination: Sources of contamination, chemical diffusion in soils, practical range of flow parameters, simultaneous flow of water, current and salts through a soil, Electro kinetic phenomenon, coupled influences on chemical flow, chemical compatibility and hydraulic conductivity.

Classification of Soil and Susceptibility to Environment: General, Susceptibility to environment, mineralogy- formation and isomorphous substitution, Factors affecting surface activity of soils, Ion-exchange and its mechanics, Theories of ion-exchange, clay-organic interactions, Atomic absorption spectroscopy analysis, Mechanisms controlling the index properties of fine grained soils.

Engineering Properties of Soil due to Changing Environment: General, Engineering properties and environment, Permeability and its mechanisms, volume change behaviour- Basic mechanisms controlling compressibility, Quasi precompression, compression behaviour of saturated Kaolinitic and Montmorillonitic clays with different pore fluids, shear strength behaviour of Kaolinitic and Montmorillonitic clays with different pore fluids, components of shear strength and their mechanisms.

Soil Modification by Environmental Changes: Stabilisation of soil by environmental changes, use of additives and their basic mechanisms, effect of lime on sulphate bearing clays, effect of phosphoric acid, use of fly ash in soil modification, use of hydroxy-aluminium in clay stabilization, stabilization by chemical transport.

Waste Containment: Overview on landfill liners, Siting considerations and geometry, typical cross-sections, grading and leachate removal, case studies.

Reading:

1. Sridharan, A. “Engineering Behaviour of Fine Grained Soils” A Fundamental Approach, IGS Annual Lecture – 1991.
2. James K. Mitchell “Fundamentals of Soil Behaviour” John Wiley & Sons, Inc. New York.1993.
3. Ramanatha Ayyar, T.S. “ Soil Engineering in Relation to Environment “ Published by LBS Centre for Science and Technology, Thiruvananthapuram, 2000.
4. Koerner, R.M. – “Designing with geosynthetics”, Pearson Education Inc., 2005.
5. David, D.E. and Koerner, R.M. “Waste Containment Facilities” ASCE Press, Allied Pub. Pvt. Ltd., 2007.

CE473	EARTHQUAKE GEOTECHNICAL ENGINEERING	DEC	3 – 0 – 0	3 Credits

Pre-requisites: Geotechnical Engineering – II.

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

CO1	Understand the earthquake mechanisms
CO2	Understand earthquake motion on soil properties and soil-structure interaction
CO3	Evaluate the seismic susceptibility of the ground
CO4	Design foundations, slopes and pavements for seismic loading

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	2	-	-	-	-	-	1	1
CO2	2	-	-	-	-	-	1	1
CO3	-	-	-	2	1	-	1	1
CO4	-	-	-	3	-	-	2	1

Detailed Syllabus:

Seismology and earthquakes**:** Basic earthquake principles: Introduction – Internal structure of earth – Plate tectonics faults – seismic waves – Seismograph – Classification of earthquakes – Magnitude and intensity of earthquakes - Seismic zones in India.

Common Earthquake effects: Surface rupture – Regional subsidence – liquefaction –slope movement – Tsunami and seiche.

Earthquake structural Damage: Earthquake induced settlement – Resonance of structures.

Soil dynamics: Dynamics of discrete system – Soil structure interaction – Vibratory system – free and forced vibration without and with damping – Base shaking – Dynamic soil properties – problems.

Geotechnical earthquake engineering analysis: Site investigation: Scope of investigation – quantitative evaluation – subsurface investigation – laboratory testing – peak ground acceleration – report preparation – problems.

Liquefaction: Introduction – mechanism – laboratory liquefaction studies – factors that govern Liquefaction in the field – Liquefaction analysis – cyclic stress ratio from the SPT, DCPT and shear wave velocity- FS against liquefaction – Anti Liquefaction measures – problems.

Earth quake induced settlement: Introduction – settlement VS factor of safety against Liquefaction induced ground damage – volumetric compression – settlement due to dynamic loads caused by rocking – problems.

Bearing capacity analysis for earthquakes: Introduction – one third increases in bearing capacity pressure for seismic condition – Bearing capacity analysis for liquefied soil – granular soil with earthquake induced pore water – Bearing capacity analysis for cohesive soil weakened by the earthquake – problems.

Slope stability analysis for earthquake: Introduction – inertia slope stability: pseudostatic method, new mark method – weakening slope stability: flow slides, liquefaction induced lateral spreading, strain softening soil – restrained retaining walls and temporary retaining walls – problems.

Other geotechnical earthquake engineering analysis: Introduction – pavement design – pipe line design – problems.

Site improvement methods to mitigate earthquake effects: Soil improvement Methods: Introduction – Grading, soil replacement, water removal, site strengthening, grouting, thermal, and ground water control methods.

Foundation analysis: Introduction – shallow and deep foundations.

Reading:

1. Kramer, S. L. (2003): “Geotechnical Earthquake Engineering”, Pearson Education.
2. Day, R. W. (2003): “Geotechnical Earthquake Engineering handbook”, McGraw Hill.
3. Kamalesh Kumar, (2008): “Basic Geotechnical Earthquake Engineering”, New Age.
4. IS-1893(part-1) 2002, “Criteria for Earthquake resistant design of structures” part 1- general provision of buildings.

CE474	GEOSYNTHETICS	DEC	3 – 0 – 0	3 Credits

Pre-requisites: Environmental Engineering.

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

CO1	Identify the functions of geosynthetics
CO2	Select the geosynthetic products
CO3	Identify the testing methods for geosynthetics
CO4	Design geosynthetic products

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	-	-	2	-	-	-	-	1
CO2	-	-	2	-	1	-	-	1
CO3	-	1	2	-	-	-	-	1
CO4	-	-	2	2	-	-	-	1

Detailed Syllabus:

Introduction: An overview on the development and applications various geosynthetics - the geotextiles, geogrids, geonets, geomembranes and geocomposites.

Designing with geotextiles: Geotextile properties and test methods – functions - Designing for separation, reinforcement, stabilization, filtration, drainage.

Designing with geogrids: Geogrid properties and test methods – physical properties, mechanical properties, endurance properties and environmental properties – Designing for grid reinforcement and bearing capacity.

Designing with geonets: Geonet properties and test methods – Physical properties, mechanical properties, hydraulic properties, endurance properties and environmental properties -Designing geonet for drainage.

Designing with geomembranes: Geomembrane properties and test methods – physical properties, mechanical properties, chemical properties and biological hazard - Applications for geomembranes.

Designing with geocomposites - Geocomposites in separation, reinforcement – reinforced geotextile composites – reinforced geomembrane composites – reinforced soil composites using discontinuous fibres and meshes, continuous fibres and three –dimensional cells, geocomposites in drainage and filtration.

Reading:

1. Sivakumar Babu G.L. “An Introduction to Soil Reinforcement and Geosynthetics” University Press, 2005.

2. Koerner, R.M. – “Designing with geosynthetics”, Pearson Education Inc., 2005.
3. Rao, G.V. – “Geosynthetics – an Introduction”, Sai Master Geoenvironmental Services Pvt. Ltd. Hyderabad, 2011.
4. Shukla, “Fundamentals of Geosynthetic Engg. Imperial College Press, London, 2006.

CE475	GLOBAL POSITIONING SYSTEM	DEC	3 – 0 – 0	3 Credits

Pre-requisites: Surveying.

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

CO1	Understand the GPS components
CO2	Choose a specific GPS receiver and GPS survey method
CO3	Interpret the navigational message and signals received by the GPS satellite
CO4	Identify location of features and map the geospatial features

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8

CO1	3	2	-	-	-	1	-	-
CO2	2	3	-	2	1	2	1	-
CO3	2	3	-	1	-	1	1	-
CO4	3	2	-	1	-	-	-	-

Detailed Syllabus:

Overview of GPS – Development of Global Surveying Techniques, History of GPS, New Satellite Navigations constellations, Basic concept of GPS, Space, Control and User segments.
GPS Observables – Structure of GPS Signal, Frequency, P Code, C/A code and data format, Generation of C/A code, Navigation data bits Pseudo range measurements, Phase measurements, system accuracy characteristics, DOP, Data format.
Surveying with GPS–Planning a GPS Survey, Positioning methods – point positioning, relative positioning, Static, Fast static, RTK, Differential Positioning, Post processing, real-time processing, Accuracy measures, software modules, Network adjustments, Dilution of Precision.
Applications of GPS – General Uses of GPS, Attitude determination, Interoperability of GPS.
Future of GPS – Modernization plans of navigational satellites, Hardware and software improvements.

Reading:

1. Bradford W. Parkinson, James Spilker, Global Positioning System: Theory and Applications, Vol. I, 1996.
2. Gunter Seeber, Satellite Geodesy Foundations, Methods and Applications, Walter de Gruyter Pub., 2003.
3. Hofmann W.B, Lichtenegger, H, Collins, J Global Positioning System – Theory and Practice, Springer-VerlagWein, 2001.

CE476	**GEOGRAPHICAL INFORMATION SYSTEM**	**DEC**	**3 – 0 – 0**	**3 Credits**

Pre-requisites: Mathematical Methods and Surveying.

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

CO1	Analyze spatial and attribute data for solving spatial problems
CO2	Preparation of geospatial features in computing environment
CO3	Create GIS and cartographic outputs for presentation
CO4	Understand the software/hardware requirements for implementing a GIS Project

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8

CO1	2	3	-	1	1	2	-	-
CO2	2	3	-	2	1	2	-	-
CO3	1	2	-	1	1	1	-	-
CO4	1	1	-	-	-	2	2	-

Detailed Syllabus:

Introduction – GIS definition, development, application areas.

Map Concept- Map-Definition, Elements of Maps, Types of maps, Advantages and disadvantages of analog/digital maps, Coordinate Systems- Geometric models of earth, Global/Local coordinate system, Projection Systems- Classification, Cylindrical projection, Conical projection, Selection of a particular projection.

Fundamental concepts of GIS – Modeling Real World Features- Raster data model, vector data model, Data Formats- Spatial and Non-Spatial data, Data collection and Input, Data conversion, Hardware & software Requirements.

Topology – Editing and Error Rectification, Types of topology, Topological Relationships.

Spatial Analysis – Buffer Analysis-Variations in Buffering, Applications of buffering, Overlay Analysis-Feature type and overlay, Vector Overlay methods, Network Analysis-Impedance, Shortest path analysis, closest facility, Concepts of Proximity analysis, Neighbourhood operations.

GIS Project Planning – Steps in GIS project, Problem Identification and Implementation of a GIS project.

GIS Applications – Transportation, Water Resources, Environment, Geology, Emergency Management, Agriculture, Real Estate.

Advances in GIS – Concepts and application of Mobile and Web GIS.

Reading:

1. C.P. Lo, Albert K. W. Yeung, Concepts and Techniques of Geographic Information Systems, Prentice Hall India Pvt. Ltd, New Delhi, 2002.
2. Kang-Tsung Chang, Introduction to Geographic Information Systems, Tata McGraw Hill Publishing Company Ltd, New Delhi, 2008.
3. Peter A. Burrough and Rachael A. McDonnell, Principles of Geographical Information Systems, Oxford University Press, 2005.

CE477	AIR AND WATER TRANSPORTATION	DEC	3 – 0 – 0	3 Credits

Pre-requisites: Transportation Engineering**.**

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

CO1	Fix the orientation of the runways
CO2	Carryout the geometrical design of the airport infrastructure
CO3	Prepare structural designs of runway, taxiway, and apron-grate area
CO4	Prepare a plan of the airport terminal area
CO5	Prepare a plan of the sea port
CO6	Provide solution to protect coastal erosion

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	-	3	-	-	-	-	-	-
CO2	-	-	-	3	-	-	-	-
CO3	-	-	-	3	-	-	-	-
CO4	-	3	-	-	-	-	-	-
CO5	-	3	-	-	-	-	-	-
CO6	-	-	-	2	1	-	-	-

Detailed Syllabus:

Air Transportation: Aircraft Characteristics - Landing gear configurations, aircraft weight, engine types, Aircraft performance characteristics: speed, payload and range, runway performance, declared distances, wingtip vortices.

Geometric Design of the Airfield **-** Airport classification: utility airports, transport airports, Runways: runway configurations, runway orientation, wind rose, estimating runway length, sight distance and longitudinal profile, transverse gradient, Taxiways and taxilanes: widths and slopes, taxiway and taxilane separation requirements, sight distance and longitudinal profile, location of exit taxiways, design of taxiway curves and intersections, end-around taxiways, Aprons: holding aprons, terminal aprons and ramps, surface gradients, Control tower visibility requirements.

Structural Design of Airport Pavements **-** Soil investigation and evaluation: CBR, plate bearing test, Young's modulus, FAA pavement design methods: equivalent aircraft, cumulative damage failure, Design of flexible and rigid airport pavements.

Airport Lighting, Marking, and Signage **-** Requirements of visual aids, approach lighting system configurations, visual approach slope aids, threshold lighting, Runway and taxiway lighting and marking, airfield signage.

Terminal Area **-** Passenger terminal system and its components, Apron gate system: number of gates, gate size, aircraft parking type, apron layout, apron circulation, passenger conveyance to aircraft.

Water Transportation: Ports and Harbours **-** Types of water transportation, water transportation in India, Ports and harbours: requirements, classification, ship characteristics, Harbour works: breakwaters, jetties, fenders, piers, wharves, dolphins, etc., Navigational aids: types, requirements, light house, beacon lights, buoys, Port facilities: general layout, development, planning, facilities, terminals.

Docks, Dredging, Coastal Erosion and Protection - Docks and repair facilities: design, dry docks, wet docks, slipways, Locks and lock gates: materials, size, Dredging: classification, dredgers, uses of dredged materials, Coastal erosion and protection: seal wall, revetment, and bulkhead.

Reading:

1. Ashford, N. J., Mumayiz, S. A., and Wright, P. H. Airport Engineering: Planning, Design and Development of 21st Century Airports, Fourth Edition, John Wiley & Sons, New Jersey, USA, 2011.
2. Horonjeff, R., McKelvey, F. X., Sproule, W. J., and Young, S. B. Planning and Design of Airports, Fifth Edition, McGraw-Hill, New York, USA, 2010.
3. Kazda, A., and Caves, R. E. Airport Design and Operation, Second Edition, Elsevier, Oxford, U.K., 2007.
4. Khanna, S. K., Arora, M. G., and Jain, S. S. Airport planning and Design, Sixth Edition, Nem Chand and Bros, Roorkee, India, 2012.
5. Kumar, V., and Chandra, S. Air Transportation Planning and Design, Galgotia Publications Pvt. Ltd., New Delhi, India, 1999.
6. Neufville, R. D., and Odoni, A. Airport Systems: Planning, Design, and Management, McGraw-Hill, New York, USA, 2003.
7. Young, S. B., and Wells, A. T. Airport Planning and Management, Sixth Edition, McGraw-Hill, New York, USA, 2011.

8. Bindra, S.P. A Course in Docks and Harbour Engineering, Dhanpat Rai and Sons, New Delhi, India, 1992.
9. Seetharaman, S. Dock and Harbour Engineering, Umesh Publications, New Delhi, India, 1999.
10. Srinivasan, R. Harbour, Dock and Tunnel Engineering, Charotar Publishing House, Anand, India, 1987.

CE478	TRAVEL DEMAND ANALYSIS	DEC	3 – 0 – 0	3 Credits

Pre-requisites: Mathematical Methods and Transportation Engineering.

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

CO1	Estimate demand for urban travel
CO2	Design urban transportation network
CO3	Estimate demand for regional travel
CO4	Design regional transportation network

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	-	2	-	-	-	3	-	-
CO2	-	-	-	3	-	-	-	-
CO3	-	2	-	-	-	3	-	-
CO4	-	-	-	3	-	-	-	-

Detailed Syllabus:

Transportation Issues - Population, Urbanization and Migration, Findings of Commission on Urbanization Introduction to Urban Transportation Urban Issues, Travel Characteristics, Concept of Region, Issues Related to Regional Transportation Planning, Methods of Delineation Regions.

Travel Demand - Trends, Overall Planning process, Long term Vs Short term planning, Demand Function, Independent Variables, Travel Attributes, Assumptions in Demand Estimation, Sequential, and Simultaneous Approaches, Aggregate and Disaggregate Techniques.

Data Collection And Inventories - Collection of data – Organisation of surveys and Analysis, Study Area, Zoning, Screen Lines, Types and Sources of Data - Road Side Interviews - Home Interview Surveys - Commercial Vehicle Surveys, Sampling Techniques, Expansion Factors - Accuracy Checks, Use of Secondary Sources, Economic data – Income – Population – Employment – Vehicle Owner Ship.

Four Stage Demand Forecasting - UTPS Approach.

Trip Generation Analysis: Zonal Models, Category Analysis, Household Models, Trip Attraction models, Commercial Trip Rates.

Trip Distribution: Growth Factor Methods, Gravity Models, Opportunity Models, Time Function Iteration Models.

Mode Choice Analysis: Mode Choice Behaviour, Competing Modes, Mode Split Curves, Models and Probabilistic Approaches.

Traffic Assignment: Basic Elements of Transport Networks, Coding, Route Properties, Path Building Criteria, Skimming Tree, All-or-Nothing Assignment, Capacity Restraint Techniques, Reallocation of Assigned Volumes, Equilibrium Assignment, Diversion Curves.

Regional Travel Demand Estimation - Factors Affecting Goods and Passenger Flows, Use of Mathematical Models to Estimate Freight and Passenger Demand, Abstract Mode Models, Mode Specific Models, Direct Demand Models, IVF Models, IO Model.

Reading:

1. Jotin Khisty C, Transportation Engineering - An Introduction, Prentice Hall, Englewood Cliffs, New Jersey, 2004.
2. Kadiyali L.R., Traffic Engineering and Transportation Planning, Khanna Publication, N.D, 2011.
3. Papakostas. C.S., Fundamentals of Transportation Engineering, PHI Pvt. Ltd., New Delhi, 2003.
4. Subhash C. Saxena, A Course in Traffic Planning and Design, Dhanpath Rai and Sons, New Delhi, 1989.

CE479	**PAVEMENT CONSTRUCTION AND MAINTENANCE**	**DEC**	**3 – 0 – 0**	**3 Credits**

Pre-requisites: Geotechnical Engineering - I, Theory of Structures – II and Transportation Engineering.

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

CO1	Select appropriate earth moving and compaction equipment depending upon the requirement
CO2	Prepare quality assurance and quality control plans in an attempt to construct better performing pavements
CO3	Evaluate the pavements based on the functional and structural characteristics
CO4	Evaluate the safety aspects of the pavements specifically in terms of friction and other related distresses
CO5	Select maintenance technique depending upon the intensity of the distresses

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	-	-	-	-	3	-	-	-
CO2	-	-	3	-	2	-	-	-
CO3	-	-	1	2	-	-	-	-
CO4	2	-	-	2	-	-	-	-
CO5	-	-	-	-	3	-	-	-

Detailed Syllabus:

Pavement Inventories And Evaluation - Factors affecting Pavement Deterioration, Functional Condition Evaluation Techniques: Roughness Measurements, serviceability concepts: Visual & Ride Rating Techniques, structural Condition Evaluation Techniques: NDT Procedures, Rebound Deflection, Measurement and Analysis, Destructive Testing, Remaining Life Concept, AI's Equivalency Factors, Overlay Design methods, IRC, Overlay Design methods, AASHTO methods, Evaluation of Pavement Safety: Skid Resistance, Factors, evaluation, Hydroplaning Reduction with Porous Overlays & Popcorn Friction overlay, Deterioration Modelling Concepts: Factors Influencing Structural & Functional Condition Deterioration, Examples of Initiation and Progressing Deterioration Models, Use of Deterioration Models by HDM Software.

Pavement Construction - Construction of Subgrade layers, Sub-base and Base Courses, Bituminous Surface Courses, Cement Concrete Surface Courses, MORTH specifications, Quality control.

Pavement Maintenance & Quality Control - Routine, Periodic Maintenance, Special Repairs, Responsive Maintenance Programmes, Rehabilitation and Reconstruction, Components of Pavement Maintenance Management System (PMMS), Stages in Implementing PMMS, Total Quality Management (TQM): Quality Assurance/Quality Control Concepts, Sampling, Tolerances and Controls Related to Profile & Compaction, Role of ISO 9000 in TQM.

Reading:

1. RCC Haas, W. Ronald Hudson, et al, Modern Pavement Management, Krieger Publishing Company.
2. ISTE Summer School Report on PMSS by Bangalore University. ISTE, New Delhi.
3. Mohammed Y. Shahin, Pavement Management for Airports, Roads & Parking Lots, Chapman & Hall Publishers.
4. Instructor's Guide-Asphalt Institute, Asphalt Technology and Construction Practices, Educational series.
5. A.F. Stocks, Concrete Pavements, Elsevier Applied Science Publishers, New York.
6. Harold N. Atkins, Highway Materials, Soils & Concrete 3rdEdition, Prentice Hall.
7. MORTH, Govt. of India, Specifications for Roads & Bridge Works, New Delhi.
8. Peurifoy, R.L., and Clifford,JS "Construction Planning Equipment and Method"- McGraw Hill Book Co. Inc.
9. Sharma S.C., "Construction Equipment and its Management"- Khanna Publishers.
10. Freddy L Roberts, Prithvi S Kandhal et al, "Hot Mix Asphalt Materials, mixture design and construction"- (2nd Edition), National Asphalt Pavement Association Research and Education Foundation, Maryland, USA.

CE480	HIGHWAY SAFETY	DEC	3 – 0 – 0	3 Credits

Pre-requisites: Transportation Engineering**.**

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

CO1	Analyze the effect of driver characteristics, roadway characteristics, and climatic factors on highway safety
CO2	Plan and design a road safety improvement program
CO3	Analyze accident data and suggest safety measures

CO4	Conduct road safety audit
CO5	Interpret accident data using statistical analysis

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	-	-	-	2	-	-	-	-
CO2	-	-	-	3	-	-	-	-
CO3	-	3	-	2	-	-	-	-
CO4	-	1	-	2	-	-	-	-
CO5	-	2	-	2	-	-	-	-

Detailed Syllabus:

Introduction to safety - Accident characteristics and factors: road – driver – vehicle-environment.

Statistical Interpretation and Analysis of Crash Data - Accident recording and analysis.

Advanced statistical methods,

Crash Reconstruction - Driver behavior and crash “causality”, Crash reporting and collision diagrams, Basics of crash statistics, Before-after methods in crash analysis.

Road Safety Audits - Safety Programs, Safety Education, Traffic Law Enforcement.

Elements of highway safety management systems, Safety countermeasures.

Safety management process, Mitigation Measures - Crash Facts, Exclusive pedestrian signal phasing, Roadway lighting, pedestrian refuge islands and curb extension.

Road Safety Management System.

Reading:

1. Institute of Transportation Engineers (ITE), The Traffic Safety Toolbox: A Primer on Traffic Safety, ITE, 1999.
2. Lynn B. Fricke, Traffic Accident Reconstruction, Northwestern University Center for Public Safety, 1990.
3. Ogden, K.W. Safer Roads: A Guide to Road Safety Engineering. Avebury Technical, 1996.
4. Rune Elvik and Truls Vaa, The Handbook of Road Safety Measures, Elsevier, 2004.
5. Leonard Evans, Traffic Safety, Science Serving Society, 2004.
6. Ezra Hauer, Observational Before-After Studies in Road Safety, Pergamon Press, 1997 (reprinted 2002).

7. Simon Washington, Matthew Karlaftis, and Fred Mannering, Statistical and Econometric Methods for Transportation Data Analysis, Chapman & Hall/CRC Press, 2003.
8. J. Stannard Baker, Traffic Collision Investigation, Northwestern University Center for Public Safety, 2002.
9. Lynn B. Fricke, Traffic Accident Reconstruction, Northwestern University Center for Public Safety, 1990.

CE390	Environmental Impact Analysis	OPC	3 – 0 – 0	3 Credits

(This course is not offered to civil engineering students)

Pre-requisites: None.

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

CO1	Identify the environmental attributes to be considered for the EIA study.
CO2	Formulate objectives of the EIA studies.
CO3	Identify the suitable methodology and prepare Rapid EIA.
CO4	Prepare EIA reports and environmental management plans.
CO5	Plan the methodology to monitor and review the relief and rehabilitation works.

Detailed Syllabus:

Introduction: The Need for EIA, Indian Policies Requiring EIA , The EIA Cycle and Procedures, Screening, Scoping, Baseline Data, Impact Prediction, Assessment of Alternatives, Delineation of Mitigation Measure and EIA Report, Public Hearing, Decision Making, Monitoring the Clearance Conditions, Components of EIA, Roles in the EIA

Process. Government of India Ministry of Environment and Forest Notification (2000), List of projects requiring Environmental clearance, Application form, Composition of Expert Committee, Ecological sensitive places, International agreements.

Identifying the Key Issues: Key Elements of an Initial Project Description and Scoping, Project Location(s), Land Use Impacts, Consideration of Alternatives, Process selection: Construction Phase, Input Requirements, Wastes and Emissions, Air Emissions, Liquid Effluents, Solid Wastes, Risks to Environment and Human, Health, Socio-Economic Impacts, Ecological Impacts, Global Environmental Issues.

EIA Methodologies**:** Criteria for the selection of EIA methodology, impact identification, impact measurement, impact interpretation & Evaluation, impact communication, Methods-Adhoc methods, Checklists methods, Matrices methods, Networks methods, Overlays methods, Environmental index using factor analysis, Cost/benefit analysis, Predictive or Simulation methods. Rapid assessment of Pollution sources method, predictive models for impact assessment, Applications for RS and GIS.

Reviewing the EIA Report: Scope, Baseline Conditions, Site and Process alternatives, Public hearing. Construction Stage Impacts, Project Resource Requirements and Related Impacts, Prediction of Environmental Media Quality, Socio-economic Impacts, Ecological Impacts, Occupational Health Impact, Major Hazard/ Risk Assessment, Impact on Transport System,Integrated Impact Assessment.

Review of EMP and Monitoring: Environmental Management Plan, Identification of Significant or Unacceptable Impacts Requiring Mitigation, Mitigation Plans and Relief & Rehabilitation, Stipulating the Conditions, What should be monitored? Monitoring Methods, Who should monitor? Pre-Appraisal and Appraisal.

Case Studies: Preparation of EIA for developmental projects- Factors to be considered in making assessment decisions, Water Resources Project, Pharmaceutical industry, thermal plant, Nuclear fuel complex, Highway project, Sewage treatment plant, Municipal Solid waste processing plant, Tannery industry.

Reading:

1. Jain, R.K., Urban, L.V., Stracy, G.S., *Environmental Impact Analysis*, Van Nostrand Reinhold Co., New York, 1991.
2. Barthwal, R. R., *Environmental Impact Assessment*, New Age International Publishers, 2002
3. Rau, J.G. and Wooten, D.C., *Environmental Impact Assessment,* McGraw Hill Pub. Co., New York, 1996.
4. Anjaneyulu.Y., and Manickam. V., Environmental Imapact Assessment Methodologies, B.S. Publications, Hyderabad, 2007.

5. Wathern.P., Environmental Impact Assessment- Theory and Practice, Routledge Publishers, London, 2004.

EE390	LINEAR CONTROL SYSTEMS	OPC	3 – 0 – 0	3 Credits

Pre-requisites: None.

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

CO1	Analyze electromechanical systems using mathematical modelling
CO2	Determine Transient and Steady State behavior of systems using standard test signals
CO3	Analyze linear and non-linear systems for steady state errors, absolute stability and relative stability
CO4	Design a stable control system satisfying requirements of stability and reduced steady state error

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	-	-	1	-	-	-	1	-
CO2	-	-	-	-	-	-	1	-
CO3	-	-	-	-	-	-	1	-
CO4	-	-	-	-	-	-	1	-

Detailed syllabus:

Introduction - control system, types, feedback and its effects-linearization

Mathematical Modelling of Physical Systems. Block diagram Concept and use of Transfer function. Signal Flow Graphs- signal flow graph, Mason's gain formula.

Time Domain Analysis of Control Systems - BIBO stability, absolute stability, Routh-Hurwitz Criterion.

P, PI and PID controllers. Root Locus Techniques - Root loci theory, Application to system stability studies.

Frequency Domain Analysis of Control Systems - polar plots, Nyquist stability criterion, Bode plots, application of Bode plots.

Reading:

1. B.C. Kuo, Automatic Control Systems, 7th Edition, Prentice Hall of India, 2009.
2. I.J. Nagarath and M. Gopal: Control Systems Engineering, 2nd Edition, New Age Pub. Co. 2008.

ME390	AUTOMOTIVE MECHANICS	OPC	3 – 0 – 0	3 Credits

Pre-requisites: None.

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

CO1	Analyze operation and performance indicators of transmission systems, internal combustion engines and after treatment devices.
CO2	Understand operation of engine cooling system, lubrication system, electrical system and ignition system.
CO3	Understand fuel supply systems in an diesel and petrol vehicles
CO4	Analyze current and projected future environmental legislation and its impact on design, operation and performance of automotive power train systems.
CO5	Understand operation and performance of suspension, steering and braking system.
CO6	Understand layout of automotive electrical system and importance of electronic

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	-	-	-	-	-	-	1	-
CO2	-	-	-	1	-	-	1	-
CO3	-	-	-	-	-	-	1	-
CO4	-	-	-	-	-	-	1	-
CO5	-	-	-	-	-	-	1	-
CO6	-	-	-	-	-	-	1	-

Detailed syllabus

Introduction: Layout of an automotive chassis, engine classification.

Cooling Systems: Air cooling, air cleaners, Water cooling: Thermosyphon and pump circulation systems, Components of water cooling systems- Radiator, thermostat etc.

Engine Lubrication: Petroils system, Splash system, Pressure lubrication and dry sump system

Ignition System: Battery, Magneto and Electronic, Engine Starting drives

Fuel supply system: Components in fuel supply system, types of feed pumps, air cleaners, fuel and oil filters, pressure and dry sump systems.

Engine testing and Performance: Performance parameters, constant and variable speed test, heat balance test, performance characteristics. Engine Emissions: SI and CI engine emissions, emission control methods

Automotive electrical and electronics: Electrical layout of an automobile, ECU, sensors, windscreen wiper, Electric horn.

Transmission: Clutch**-** Single and multiplate clutch, semi & centrifugal clutch and fluid flywheel, Gear box: Sliding mesh, constant mesh and synchromesh gear box, selector mechanism, over drive, Propeller shaft and Differential.

Suspension System: Front and rear suspension, shock absorbers, Rear Axles mountings, Front Axle. Steering Mechanism: Manual and power steering systems, Braking System: Mechanical, Hydraulic and Air braking systems.

Engine service: Engine service procedure.

Reading:

1. S. Srinivasan, Automotive Mechanics, Tata McGraw-Hill, 2004.
2. K.M.Gupta, Automobile Engineering, Vol.1 and Vol.2, Umesh Publications, 2002
3. Kirpal Singh, Automobile Engineering, Vol.1 and Vol.2, Standard Publishers, 2003.
4. William H.Crouse and Donald L. Anglin, Automotive Mechanics, Tata McGraw-Hill, 2004
5. Joseph Heitner, Automotive Mechanics, East-West Press, 2000.

ME391	ROBUST DESIGN	OPC	3 – 0 – 0	3 Credits

Pre-requisites: None.

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

CO1	Understand stages in engineering design and concept of robust design.
CO2	Develop quality loss functions and S/N ratios for S, N and L type objective functions.
CO3	Identify control and noise factors for a given product or process.
CO4	Conduct experiments using DOE concepts to decide the optimal setting of parameters
CO5	Apply quality loss function approach for fixing the component tolerances.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	1	-	-	2	-	-	1	-
CO2	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-

Detailed syllabus

Introduction: Taguchi's quality philosophy, causes of performance variation, concept of robust design, stages in product/process design, need for experimentation, QFD, process flow analysis, cause and effect diagram.

Design of Experiments**:** Principles of experimentation, Basic concepts of probability and statistics, Comparison of two means and two variances, Comparison of multiple (more than two) means & Anova, Factorial designs, fractional factorial designs, orthogonal arrays, standard orthogonal arrays & interaction tables, modifying the orthogonal arrays, selection of suitable orthogonal array design, analysis of experimental data.

Parameter Design**:** Loss function, average quality loss, S/N ratios, objective functions, selection of control & noise factors and their levels, strategy for systematic sampling of noise, classification of control factors, inner-array and outer-array design, data analysis, selection of optimum levels/values for parameters.

Tolerance Design: Experiments, selection of tolerances to be tightened, fixing the final tolerances.

Reading:

1. Taguchi G, Chowdhury S and Taguchi S, Robust Engineering, TMH, 2000.
2. Ross PJ, Taguchi Techniques for Quality Engineering, TMH, 2005.

ME392	ENTREPRENEURSHIP DEVELOPMENT	OPC	3 – 0 – 0	3 Credits

Pre-requisites: None.

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

CO1	Understand entrepreneurship and entrepreneurial process and its significance in economic development.
CO2	Develop an idea of the support structure and promotional agencies assisting ethical entrepreneurship.
CO3	Identify entrepreneurial opportunities, support and resource requirements to launch a new venture within legal and formal frame work.
CO4	Develop a framework for technical, economic and financial feasibility.
CO5	Evaluate an opportunity and prepare a written business plan to communicate business ideas effectively.
CO6	Understand the stages of establishment, growth, barriers, and causes of sickness in industry to initiate appropriate strategies for operation, stabilization and growth.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	1	-	-	1	-	-	1	1
CO2	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	1	-
CO6	-	-	-	-	1	-	1	1

Detailed syllabus

Entrepreneur and Entrepreneurship: Introduction; Entrepreneur and Entrepreneurship; Role of entrepreneurship in economic development; Entrepreneurial competencies and motivation; Institutional Interface for Small Scale Industry/Enterprises.

Establishing Small Scale Enterprise: Opportunity Scanning and Identification; Creativity and product development process; Market survey and assessment; choice of technology and selection of site.

Planning a Small Scale Enterprsies**:** Financing new/small enterprises; Techno Economic Feasibility Assessment; Preparation of Business Plan; Forms of business organization/ownership.

Operational Issues in SSE**:** Financial management issues; Operational/project management issues in SSE; Marketing management issues in SSE; Relevant business and industrial Laws.

Performance appraisal and growth strategies**:** Management performance assessment and control; Causes of Sickness in SSI, Strategies for Stabilization and Growth.

Reading:

1. G.G. Meredith, R.E.Nelson and P.A. Neek, The Practice of Entrepreneurship, ILO, 1982.
2. Dr. Vasant Desai, Management of Small Scale Enterprises, Himalaya Publishing House, 2004.
3. A Handbook for New Entrepreneurs, Entrepreneurship Development Institute of India, Ahmedabad, 1988.
4. Bruce R Barringer and R Duane Ireland, Entrepreneurship: Successfully Launching New Ventures, 3rd ed., Pearson Edu., 2013.

EC390	COMMUNICATION SYSTEMS	OPC	3 – 0 – 0	3 Credits

Pre-requisites: None

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

CO1	Understand different modulation and demodulation schemes for analog communications.
CO2	Design analog communication systems to meet desired application requirements
CO3	Evaluate fundamental communication system parameters, such as bandwidth, power, signal to quantization noise ratio etc.
CO4	Elucidate design tradeoffs and performance of communications systems.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	-	-	-	-	-	-	1	-
CO2	-	-	-	-	-	-	1	-
CO3	-	-	-	-	-	-	1	-
CO4	-	-	-	-	-	-	1	-

Detailed syllabus

Signal Analysis**:** Communication Process, Sources of Information, Communication Channels, Modulation Process, Types of Communication, Random Process, Gaussian Process, Correlation Function, Power Spectral Density, Transmission of Random Process through an LTI Filter.

Noise Analysis: External Noise, Internal Noise, White Noise, Narrow Band Noise, Representation of Narrow Band noise In phase and Quadrature Components, Noise Figure, Noise Bandwidth, Noise Temperature.

Amplitude (Linear) Modulation: Linear Modulation Schemes, Generation of AM, Envelope Detector, DSB-SC Product Modulator, Switching Modulator, Ring Modulator, Coherent Detection, Costas receiver, SSB Signal Representation, Filtering Method, Phase Shift Method, Coherent Demodulation, VSB Modulator and Demodulator, Carrier Acquisition using Squaring Loop and Costas Loop, Receiver Model, SNR, Noise in SSB and DSB receivers using coherent detection, Noise in AM Receiver using Envelope detection, Threshold Effect.

Angle (Exponential) Modulation: Types of Angle Modulation, Relation between FM and PM, Narrow Band FM, Wideband FM, Transmission Bandwidth of FM Signals, Generation of FM using Direct and Indirect methods, FM Demodulation using Slope Circuit, Frequency

Discriminator, Interference in Angle Modulation, Noise in FM Receiver, FM Threshold Effect, Pre-emphasis and De-emphasis in FM, Model of PLL for FM Demodulation.

Pulse Modulation: Sampling Process, PAM, PWM, PPM, Quantization, PCM, TDM, Digital Multiplexer Hierarchy, DM, DSM, Linear Prediction, DPCM, ADPCM, Noise in PCM System, Companding, Comparison of the Noise Performance of AM,FM,PCM and DM.

Information Theory: Uncertainty, Information, Entropy, Source Coding Theorem, Data Compaction, Mutual information, Channel Capacity, BSC Channel, Information Capacity Theorem, Bandwidth - Power Tradeoff, Huffman Coding.

Reading:

1. S. Haykin, Communication Systems, 4th Edn, John Wiley & Sons, Singapore, 2001.
2. B.P. Lathi, Modern Digital & Analog Communication Systems, 3rd Edn, Oxford University Press, Chennai, 1998.
3. Leon W.Couch II., Digital and Analog Communication Systems, 6th Edn, Pearson Education inc., New Delhi, 2001.
4. A Bruce Carlson, PB Crilly, JC Rutledge, Communication Systems – 4th Edn, MGH, New York, 2002.

EC391	MICROPROCESSOR SYSTEMS	OPC	3 – 0 – 0	3 Credits

Pre-requisites: None

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

CO1	Develop basic understanding of microprocessor architecture.
CO2	Design Microprocessor and Microcontroller based systems.
CO3	Understand C, C++ and assembly language programming
CO4	Understand concept of interfacing of peripheral devices and their applications

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	-	1	-	-	-	-	1	-
CO2	-	-	-	-	-	-	1	-
CO3	-	2	-	-	-	-	1	-
CO4	-	1	-	-	-	-	1	-

Detailed syllabus

Microcomputer Organization: CPU, Memory, I/O, Operating System, Multiprogramming, Multithreading, MS Windows

80386 Micro Processors : Review of 8086,salient features of 80386,Architecture and Signal Description of 80386,Register Organization of 80386,Addressing Modes,80386 Memory management, Protected mode, Segmentation, Paging, Virtual 8086 Mode, Enhanced Instruction set of 80386, the Co- Processor 80387

Pentium & Pentium-pro Microprocessor: Salient features of Pentium microprocessor, Pentium architecture, Special Pentium registers, Instruction Translation look aside buffer and branch Prediction, Rapid Execution module, Memory management, hyper-threading technology, Extended Instruction set in advanced Pentium Processors

Microcontrollers: Overview of micro controllers-8051 family microcontrollers, 80196 microcontrollers family architecture, instruction set, pin out, memory interfacing.

ARM Processor Fundamentals: Registers, current Program Status Registers, Pipeline Exceptions, Interrupts and Vector Table, Architecture Revisions, ARM Processor families, ARM instruction set, Thumb Instruction set-Exceptions Handing, Interrupts, Interrupt Handling schemes, firmware, Embedded operating systems, Caches-cache architecture, Cache policy, Introduction to DSP on the ARM, DSP on the ARM7TDMI,ARM9TDMI.

Case study-Industry Application of Microcontrollers

Reading:

1. Barry B.Brey: Intel Microprocessor Architecture, Programming and Interfacing-8086/8088,80186,80286,80386 and 80486, PHI,1995.
2. Muhammad Ali Mazidi and Mazidi: The 8051 Microcontrollers and Embedded systems, PHI, 2008
3. Intel and ARM Data Books on Microcontrollers.

MM390	METALLURGY FOR NON-METALLURGISTS	OPC	3 – 0 – 0	3 Credits

Pre-requisites: None

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

CO1	Understand the characteristics and usefulness of metals and alloys.
CO2	Differentiate metals and alloys and their fabrication techniques.
CO3	Correlate the microstructure, properties, processing and performance of materials.
CO4	Select metal/alloy for engineering applications.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	-	-	1	-	-	-	1	-
CO2	-	-	1	-	-	-	1	-
CO3	-	-	1	-	-	-	1	-
CO4	-	-	1	-	-	-	1	-

Detailed Syllabus:

Introduction to Metallurgy:

Structure of Metals and Alloys: Nature of Metallic Bonding, Crystal Structures of Metals, Structure of Alloys, Imperfections in Crystals

Mechanical Properties: Plastic Deformation Mechanisms, Tensile, Creep, Fatigue, Fracture

Strengthening Mechanisms: Strain Hardening, Grain Size Refinement, Solid Solution Strengthening, Precipitation Hardening

Discovering Metals: Overview of Metals, Modern Alloy Production

Fabrication and Finishing of metal products: Metal Working and Machining

Testing of Metals: Both Destructive and Non-Destructive, Inspection and Quality Control of Metals

Engineering Alloys: Steel Products and Properties, Cast Irons, Tool Steels and High Speed Steels, Stainless Steels, Nonferrous Metals

Heat Treatment: Annealing, Normalizing, Hardening, Tempering

Corrosion and its Prevention: Electro chemical considerations, Corrosion Rates, Passivity, Environmental Effects, Forms of Corrosion, Corrosion Environments, Oxidation; Durability of Metals and Alloys

The material selection processes: Case studies

Reading:

1. M. F. Ashby: Engineering Metals, 4th Edition, Elsevier, 2005.
2. R. Balasubramaniam (Adapted): Calister's Materials Science and Engineering, 7th Edition, Wiley India (P) Ltd, 2007.
3. Reza Abbaschian, Lara Abbaschian, R E Reed-Hill: Physical Metallurgy Principles, Affiliated East-West Press, 2009.
4. V Raghavan: Elements of Materials Science and Engineering- A First Course, 5th Edition, PHI, 2006

CH390	**Nanotechnology and Applications**	**OPC**	**3 – 0 – 0**	**3 Credits**

Prerequisites: None

CO1	Understand the properties of Nano-materials and applications

CO2	Apply chemical engineering principles to Nano-particle production
CO3	Solve the quantum confinement equations.
CO4	Characterize Nano-materials.
CO5	Scale up the production Nanoparticles for Electronics and Chemical industries.

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

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	1	1	-	-	-	-	1	1
CO2	-	-	-	-	-	-	1	1
CO3	-	-	1	-	-	-	1	1
CO4	-	-	2	-	-	-	1	1
CO5	-	-	-	-	-	-	1	1

Detailed Syllabus:

Introduction to Nanotechnology: Introduction to nanotechnology and materials, Nanomaterials, Introduction to nano-sizes and properties comparison with the bulk materials, Different shapes and sizes and morphology.

Fabrication of Nanomaterials: Top Down Approach Grinding, Planetory milling and Comparison of particles, Bottom Up Approach, Wet Chemical Synthesis Methods, Microemulsion Approach, Colloidal Nanoparticles Production, Sol Gel Methods, Sonochemical Approach, Microwave and Atomization, Gas phase Production Methods : Chemical Vapour Depositions.

Kinetics at Nanoscale: Nucleation and growth of particles, Issues of Aggregation of Particles, Oswald Ripening, Stearic hindrance, Layers of surface charges, Zeta Potential and pH.

Carbon Nanomaterials: Synthesis of carbon bucky-balls, List of stable carbon allotropes extended, fullerenes, metallofullerenes, solid C_{60}, bucky onions, nanotubes, nanocones

Quantum mechanics: Quantum dots and its Importance, Pauli exclusion principle, Schrödinger's equation, Application of quantum Dots: quantum well, wire, dot, characteristics of quantum dots, Synthesis of quantum dots Semi-conductor quantum dots

Nanomaterials characterization: Fractionation principles of Particle size measurements, Particle size and its distribution, XRD, Zeta potential, Electronic band structure Electron statistics Application: Optical transitions in solids, photonic crystals,

Microscopies SEM, TEM, Atomic Forced Microscopy, Scanning and Tunneling Microscopy.

Applications: Self-assembly and molecular manufacturing, Surfactant based system Colloidal system applications, Functional materials Applications, commercial processes of synthesis of nanomaterials.

Nano inroganic materials of $CaCO_3$ synthesis, Hybrid Waste Water Treatments systems, Electronic Nanodevices,

Nanobiology: Biological synthesis of nanoparticles and applications in drug delivery, Nanocontainers and Responsive Release of active agents, Layer by Layer assembly for nanospheres, Safety and health Issues of nano materials, Environmental Impacts, Case Study for Environmental and Societal Impacts

Reading:

1. Kulkarni Sulabha K, Nanotechnology: Principles and Practices, Capital Publishing Company, 2007
2. Stuart M. Lindsay, Introduction to Nanoscience, Oxford University Press, 2009.
3. Robert Kelsall, Ian Hamley, Mark Geoghegan, Nanoscale Science and Technology, John Wiley & Sons, 2005.
4. Gabor L. Hornyak , H.F. Tibbals , Joydeep Dutta , John J. Moore Introduction to Nanoscience and Nanotechnology CRC Press
5. Davies, J.H. 'The Physics of Low Dimensional Semiconductors: An Introduction', Cambridge University Press, 1998.

CH391	Industrial Safety and Hazards	OPC	3 – 0 – 0	3 Credits

Prerequisites: None.

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

CO1	Analyze the effects of release of toxic substances.
CO2	Select the methods of prevention of fires and explosions.
CO3	Understand the methods of hazard identification and preventive measures.
CO4	Assess the risks using fault tree diagram.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	-	-	-	-	-	1	1	-
CO2	-	-	-	-	-	1	1	-
CO3	-	-	-	1	-	1	1	-
CO4	-	-	-	-	-	1	1	-

Detailed syllabus:

Introduction-Safety Programs, Engineering Ethics, Accident and Loss Statistics, Acceptable Risk, Public Perceptions ,The Nature of the Accident Process ,Inherent Safety.

Industrial Hygiene- Anticipation and Identification, Hygiene Evaluation, Hygiene Control. Toxic Release and Dispersion Models- Parameters Affecting Dispersion, Neutrally Buoyant Dispersion Models, Dense Gas Dispersion, Toxic Effect Criteria, Effect of Release Momentum and Buoyancy, Release Mitigation.

Fires and Explosions- The Fire Triangle, Distinction between Fires and Explosions, Flammability Characteristics of Liquids and Vapors, Limiting Oxygen Concentration and Inerting, Flammability Diagram

Hazards Identification- Process Hazards Checklists, Hazards Surveys, Hazards and Operability Studies, Safety Reviews.

Risk Assessment- Review of Probability Theory, Event Trees, Fault Trees.

Safety Procedures: Process Safety Hierarchy, Managing Safety, Best Practices, Procedures—Operating, Procedures—Permits, Procedures—Safety Reviews and Accident Investigations.

Reading:

1. D. A. Crowl and J.F. Louvar, Chemical Process Safety (Fundamentals with Applications), Prentice Hall,2011.
2. R.K. Sinnott, Coulson & Richardson's Chemical Engineering, Vol. 6, Elsevier India, 2006.

CS390	OBJECT ORIENTED PROGRAMMING	OPC	3 – 0 – 0	3 Credits

Pre-requisites: None

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

CO1	Understand fundamental concepts in object oriented approach.
CO2	Analyze design issues in developing OOP applications.
CO3	Write computer programs to solve real world problems in Java.
CO4	Analyze source code API documentations.
CO5	Create GUI based applications.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	-	-	-	-	-	-	1	-
CO2	-	-	-	-	-	-	1	-
CO3	-	-	-	-	-	-	1	-
CO4	-	-	-	-	-	-	1	-
CO5	-	-	-	-	-	-	1	-

Detailed Syllabus:

Object- oriented thinking, History of object-oriented programming, overview of java, Object-oriented design, Structure of java program. Types and modifiers, Classes, declaring objects in classes, Methods, constructors, garbage collection, Method overloading, passing objects as parameters, Inheritance, various forms and types of inheritance, Multilevel hierarchy, use of super, method overriding, Applications of method overriding, abstract classes, Packages with examples

Interfaces and implementation, Exception handling, types, throwing, creating own exceptions, Multithreading and concepts, its usage and examples, Input/output streams, String operations and examples, Collection classes-array, stack collection, bitset collection, Utility classes-string tokenizer, bitset, date, Applets- methods, creation, designing and examples, Event handling-event classes, Event listener interfaces, AWT classes, working with frames, AWT controls-layout manager, user interface components, Graphics programming

Reading:

1. Timothy Budd, “Understanding object-oriented programming with Java”, Pearson,
2. Herbert Schildt, “ The complete reference Java 2”, TMH,

BT390	GREEN TECHNOLOGY	OPC	3 – 0 – 0	3 Credits

Pre-requisites: Chemistry

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

CO1	Address smart energy and green infrastructure
CO2	Build models that simulate sustainable and renewable green technology systems
CO3	Understand the history, global, environmental and economical impacts of green technology
CO4	Address non-renewable energy challenges

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	1	-	-	-	-	1	1	-
CO2	-	-	-	-	-	-	1	-
CO3	-	-	-	-	-	-	1	-
CO4	1	-	-	-	-	1	1	-

Detailed Syllabus:

Biomass Energy, basic concepts, sources of biomass energy, uses of biomass energy, science and engineering aspects of biomass energy, production of biomass electricity, transmission of biomass electricity, storage of biomass electricity.

Energy transformation from source to services; Energy sources, sun as the source of energy; biological processes; photosynthesis; food chains, classification of energy sources, quality and concentration of energy sources; fossil fuel reserves - estimates, duration; theory of renewability, renewable resources; overview of global/ India's energy scenario.

Environmental effects of energy extraction, conversion and use; sources of pollution from energy technologies, Criteria for choosing appropriate green energy technologies, life cycle cost; the emerging trends – process/product innovation-, technological/ environmental leap-frogging; Eco/green technologies for addressing the problems of Water, Energy, Health, Agriculture and Biodiversity.

First and second laws of thermodynamics and their applications – Thermodynamic processes - Irreversibility of energy – Entropy. Properties of steam and classification of steam engines. Carnot cycle - Rankine cycle, Current energy requirements, growth in future energy requirements, Review of conventional energy resources- Coal, gas and oil reserves and resources, Tar sands and Oil, Shale, Nuclear energy Option.

Biomass fuels, market barriers of biomass fuels, biomass fuel standerdization, biomass fuel life cycle, Sustainability of biomass fuels, economics of biomass fuels, Fuel stoichiometry and analysis: Fuel stoichiometry relations; Estimation of air required for complete combustion; Estimation of minimum amount of air required for a fuel of known composition; Estimation of dry flue gases for known fuel composition; Calculation of the composition of fuel & excess air supplied, from exhaust gas analysis; Dew point of products; Flue gas analysis (O_2, CO_2, CO, NOx, SOx).

Biomass as a major source of energy in India: Fuel-wood use in rural households. Consequences for ecosystems. Future energy scenario in rural areas. Utilization of biomass in industrial and semi-industrial settings. Future utilization of biomass in India. Future of landscape management: optimal management.

Reading:

1. Ayhan Demirbas, Green Energy and Technology, Biofuels, Securing the Planet's Future Energy Needs, 1st Edition, Springer, 2009.
2. Jay Cheng, Biomass to Renewable Energy Processes, 1st Edition, CRC press, 2009.

3. Samir K. Khanal, Rao Y. Surampally, 1st edition, American Society of Civil Engineers, 2010.

SM390	MARKETING MANAGEMENT	OPC	3 – 0 – 0	3 Credits

Pre-requisites: None

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

CO1	Understand concepts and scope of marketing and market oriented strategic planning
CO2	Analyze macro level environment
CO3	Identify factors influencing consumer behavior in competitive global business environment
CO4	Identify tools and techniques for marketing management through integrated marketing communication systems.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	-	-	-	-	1	-	1	-
CO2	-	-	-	-	1	-	1	-
CO3	-	-	-	-	1	-	1	-
CO4	-	-	-	-	1	-	1	-

Detailed Syllabus:

Importance of Marketing, Scope of Marketing, Core Marketing concepts company orientation towards market place-production concept, Product concept, selling concept and Marketing concept.

Market oriented Strategic planning – Defining corporate Mission and Vision Statement at Corporate level and at Business unit level. Assigning resources to Strategic Business units through B.C.G Matrix and G.E Model.

Analyzing Macro environment-Demographic environment. Economic Environment, Technical Environment, Social-Cultural Environment and political – Legal Environment.

Components of Marketing information systems- Internal Records, Marketing intelligence, Marketing research and Marketing Decision support system.

Consumer Behavior- Buying Decision process and the factors influencing consumer Behavior-Psychological factors, social factors, cultural factors and personal factors.

Importance of Market segmentation, Target market selection and positioning.

Importance of new product development process and the various stages involved.

The concept of product lifecycle and the various strategies used by the marketer in each stage.

Product characteristics and classification, Product mix and product line decisions Branding Decisions, Building Brand Equity.

Importance of Pricing, Factors influencing pricing decisions. Various pricing methods-cost based and demand based methods.

Role of Marketing channels-Channel functions and channel levels channel Design and channel Management Decisions, Managing Retailing. Wholesaling and logistics. Importance of Electronic channels.

Importance of integrated Marketing communication. Advantages and Disadvantages of Various promotional tools- Advertising, Sales promotion, personal selling, publicity and public Relations and Direct marketing.

Reading:

1. Philip Kotler, Marketing Management, PHI, 14th Edition, 2013.
2. William Stonton & Etzel, Marketing Management, TMH, 13th Edition, 2013.
3. Rama Swamy & Namakumari, Marketing Management, McMillan, 2013.

MA390	NUMERICAL SOLUTION OF DIFFERENTIAL EQUATIONS	OPC	3 – 0 – 0	3 Credits

Pre-requisites: None

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

CO1	Solve nonlinear differential equations by numerical methods.
CO2	Determine the convergence region for a finite difference method.
CO3	Solve elliptic PDE by finite difference method
CO4	Solve a parabolic PDE by finite difference method
CO5	Solve a hyperbolic PDE by finite difference method

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	1	-	-	1	-	1	1	1
CO2	-	-	-	1	-	1	1	1
CO3	-	-	-	1	-	1	1	1
CO4	-	-	-	1	-	1	1	1
CO5	-	-	-	1	-	1	1	1

Detailed Syllabus:

Ordinary Differential Equations: Multistep (explicit and implicit) methods for initial value problems, Stability and Convergence analysis, Linear and nonlinear boundary value problems, Quasi-linearization, Shooting methods

Finite difference methods: Finite difference approximations for derivatives, boundary value problems with explicit boundary conditions, implicit boundary conditions, error analysis, stability analysis, convergence analysis.

Partial Differential Equations: Classification of partial differential equations, finite difference approximations for partial derivatives and finite difference schemes for Parabolic equations, Schmidt's two level, multilevel explicit methods, Crank-Nicolson's two level, multilevel implicit methods, Dirichlet's problem, Neumann problem, mixed boundary value problem, stability analysis.

Hyperbolic Equations: Explicit methods, implicit methods, one space dimension, two space dimensions, ADI methods.

Elliptic equations: Laplace equation, Poisson equation, iterative schemes, Dirichlet's problem, Neumann problem, mixed boundary value problem, ADI methods.

Reading:

1. M.K. Jain, Numerical Solution of Differential Equations, Wiley Eastern, 1984.
2. G.D. Smith, Numerical Solution of Partial Differential Equations, Oxford Univ. Press, 2004.
3. M.K.Jain, S.R.K. Iyengar and R.K. Jain, Computational Methods for Partial Differential Equations, Wiley Eastern, 2005.

MA391	FUZZY MATHEMATICS AND APPLICATIONS	OPC	3 – 0 – 0	3 Credits

Pre-requisites: None.

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

CO1	Apply operations on Fuzzy sets
CO2	Solve problems related to Propositional Logic.
CO3	Apply Fuzzy relations to cylindric extensions.
CO4	Apply logic of Boolean Algebra to switching circuits.
CO5	Develop Fuzzy logic controllers

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	-	-	-	1	1	1	1	1
CO2	-	-	-	1	1	1	1	1
CO3	-	-	-	1	1	1	1	1
CO4	-	-	-	1	1	1	1	1
CO5	-	-	-	1	1	1	1	1

Detailed Syllabus:

Crisp set theory (CST): Introduction, Relations between sets, Operations on sets, Characteristic functions, Cartesian products of crisp sets, crisp relations on sets.

Fuzzy set theory (FST): Introduction, concept of fuzzy set (FS), Relation between FS, operations on FS, properties of standard operations, certain numbers associated with a FS, certain crisp sets associated with FS, Certain FS associated with given FS, Extension principle.

Propositional Logic (PL1): Introduction, Syntax of PL1, Semantics of PL1, certain properties satisfied by connectives, inference rules, Derivation, Resolution.

Predicate Logic (PL2): Introduction, Syntax of PL2, Semantics of PL2, certain properties satisfied by connectives and quantifiers, inference rules, Derivation, Resolution

Fuzzy Relations (FR): Introduction, Operations on FR, □-cuts of FR, Composition of FR, Projections of FR, Cylindric extensions, Cylindric closure, FR on a domain.

Fuzzy Logic (FL): Introduction, Three-valued logics, N-valued logics and infinite valued logics, Fuzzy logics, Fuzzy propositions and their interpretations in terms of fuzzy sets, Fuzzy rules and their interpretations in terms of FR, fuzzy inference, More on fuzzy inference, Generalizations of FL.

Switching functions (SF) and Switching circuits (SC): Introduction, SF, Disjunctive normal form, SC, Relation between SF and SC, Equivalence and simplification of circuits, Introduction of Boolean Algebra BA, Identification, Complete Disjunctive normal form.

Applications: Introduction to fuzzy logic controller (FLC), Fuzzy expert systems, classical control theory versus fuzzy control, examples, working of FLC through examples, Details of FLC, Mathematical formulation of FLC, Introduction of fuzzy methods in decision making.

Reading:

1. M. Ganesh, Introduction to Fuzzy Sets and Fuzzy Logic, PHI, 2001.
2. G.J. Klir and B.Yuan, Fuzzy sets and Fuzzy Logic–Theory and Applications, PHI, 1997.
3. T. J. Ross, Fuzzy Logic with Engineering Applications, McGraw-Hill, 1995.

PH390	MEDICAL INSTRUMENTATION	OPC	3 – 0 – 0	3 Credits

Pre-requisites: None.

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

CO1	Understand the origin of bio-potentials and their physical significance.
CO2	Understand anatomy and functioning of human heart and its common problems.
CO3	Analyze ECG, ENG and EMG signals and instrumentation.
CO4	Compare different techniques of measuring blood pressure, blood flow and volume.
CO5	Interpret the principle and operation of therapeutic and prosthetic devices.
CO6	Differentiate between the various techniques for measurement of parameters.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	-	-	-	-	-	-	1	-
CO2	-	-	-	-	-	-	1	-
CO3	-	-	-	-	-	-	1	-
CO4	-	-	-	-	-	-	1	-
CO5	-	-	-	-	-	-	1	-
CO6	-	-	-	-	-	-	-	-

Detailed Syllabus:

General Introduction: The cell, body fluids, Musculoskeletal system, respiratory system, gastrointestinal system, Nervous system, endocrine system and circulatory system.

Origin of Bio potentials: electrical activity of Excitable cells: the resting state, The active state, Volume conductor fields, Functional organization of the peripheral nervous system: Reflex are & Junctional transmission.

The Electroneurogram (ENG): The H-Reflex, The Electromyogram (EMG), The Electrocardiogram (ECG), heart and the circulatory system, Electro conduction system of the heart and heart problems, ECG waveform and Physical significance of its wave features, Electrical behavior of cardiac cells, The standard lead system, The ECG preamplifier, DC ECG Amplier, Defibrillator protection circuit, Electro surgery Unit filtering, Functional blocks of ECG system, Multichannel physiological monitoring system, Common problems encountered and remedial techniques.

Blood Pressure: indirect measurement of blood pressure, korotkoff sounds, auscultatory method using sphygmo manometer, Oscillometric and ultrasonic non invasive pressure measurement, Direct measurement of blood pressure H2O manometers, electronic manometry, Pressure transducers,. Pressure amplifier designs, Systolic, diastolic mean detector circuits

Blood flow and Volume Measurement: indicator dilution methods, Transit time flow meter, DC flow meter, Electromagnetic flow meter AC electromagnetic flow meter, Quadrature suppression flow meter, Ultrasonic flow meter, Continuous-wave Doppler flow meter, Electric impedance plethysmography, chamber plethysmography, Photo plethysmography.

Pulse Oximetr: Principles of Operation, Absorption Spectrum, Sensor design, Pulse oximeter, Therapeutic and Prosthetic Devices.

Cardiac Pacemakers: Lead wires and electrodes, Synchronous Pacemakers, rate responsive pacemaking, Defibrillators, cardioverters, Electrosurgical unit, Therapeutic applications of laser, Lithotripsy Haemodialysis.

Reading:

1. John G Webster, Medical Instrumentation: Application and Design , John Wiley,3rd Ed. 2012.
2. Joseph J. Carr & John M. Brown , Introduction to biomedical Equipment Technology, 4th Ed., Prentice Hall India, 2001

PH391	ADVANCED MATERIALS	OPC	3 – 0 – 0	3 Credits

Pre-requisites: None.

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

CO1	Understand the synthesis and properties of nanomaterials
CO2	Evaluate the usefulness of nanomaterials in medicine, biology and sensing
CO3	Understand modeling of composite materials by finite element analysis
CO4	Differentiate superconducting materials
CO5	Understand the characteristics and uses of functional materials

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	-	-	1	-	-	-	1	-
CO2	-	-	1	-	-	-	1	-
CO3	1	-	-	1	-	-	1	-
CO4	1	1	1	-	-	-	1	-
CO5	1	1	1	-	-	-	1	-

Detailed Syllabus:

Nano Materials: Origin of nano technology, Classification of nano materials, Physical, chemical, electrical, mechanical properties of nano materials. Preparation of nano materials by plasma arcing, physical vapour deposition, chemical vapour deposition (CVD), Sol-Gel, electro deposition, ball milling, carbon nano tubes(CNT).Synthesis, preparation of nanotubes, nano sensors, Quantum dots, nano wires,nano biology, nano medidcines.

Biomaterials: Overview of biomaterials. Biomaterials, bioceramics, biopolymers, tissue grafts, soft tissue applications, cardiovascular implants, biomaterials in ophthalmology, orthopeadiac implants, dental materials.

Composites: General characteristics of composites , composites classes, PMCs, MMCs, CMCs, CCCs, IMCs, hybrid composites, fibers and matrices, different types of fibers, whiskers, different matrices materials, polymers, metal, ceramic matrices, toughening mechanism, interfaces, blending and adhesion, composite modeling, finite element analysis and design.

Optical materials: Mechanisms of optical absorption in metals, semiconductors and insulators. Nonlinear optical materials, optical modulators, optical fibers. Display devices and materials photo-emissive, photovoltaic cells, charge coupled devices(CCD), laser materials.

Super conducting materials: Types of super conductors, an account of mechanism of superconductors, effects of magnetic field currents, thermal energy, energy gap, acoustic attenuation, penetration depth, BCS theory, DC and AC Josephson effects, high Tc superconductors, potential applications of superconductivity, electrical switching element, superconductor power transmission and transformers, magnetic mirror, bearings, superconductor motors, generators, SQUIDS etc.

Smart materials: An introduction, principles of smart materials, input – output decision ability, devices based on conductivity changes, devices based on changes in optical response, biological systems smart materials. Devices based on magnetization, artificial structures, surfaces, hetero structures, polycrystalline, amorphous, liquid crystalline materials.

Surface Acoustic Wave (SAW) Materials and Electrets: Delay lines, frequency filters, resonators, Pressure and temperature sensors, Sonar transducers. Comparison of electrets with permanent magnets, Preparation of electrets, Application of electrets..

Reading:

1. T.Pradeep, Nano: The Essentials; TaTa McGraw-Hill,2008.
2. B.S. Murthy et al., Textbook of Nano science and Nanotechnology, University press
3. Krishan K Chawla, Composite Materials; 2nd Ed., Springer 2006.

CY390	INSTRUMENTAL METHODS IN CHEMICAL ANALYSIS	OPC	3 – 0 – 0	3 Credits

Pre-requisites: None.

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

CO1	Characterize materials using ultraviolet and visible absorption and fluorescence techniques
CO2	Analyze materials, minerals and trace samples using atomic absorption, emission and X-ray fluorescence techniques
CO3	Analyze environmental, industrial, production-line materials by liquid, gas and size-exclusion chromatographic techniques.
CO4	Characterize interfaces and traces of surface adsorbed materials using electro-analytical techniques
CO5	Understand principles of thermogravimetry and differential thermal analyses.
CO6	Characterize chemical, inorganic and engineering materials using analytical techniques

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	-	-	2	-	-	-	1	-
CO2	-	-	2	-	-	-	1	2
CO3	-	-	2	-	-	-	1	2
CO4	-	-	2	-	-	-	1	2
CO5	-	-	2	-	-	-	1	-
CO6	-	-	2	-	-	-	1	-

Detailed Syllabus:

UV-Visible Spectrophotometry and Fluorescence Beer-Lambert's law, limitations, Molecular fluorescence, influencing factors, basic instruments, standardization, quantitative methods, applications.

Atomic spectrometry, atomic absorption, X-ray fluorescence methods Flame atomic emission and absorption, flame emission photometer, flame absorption spectrometer, spectral interferences, quantitative aspects, X-ray fluorescence principle, Instrumentation, quantitative analysis.

Separation techniques Solvent extraction, Principle, Extraction of solutes, Soxhlet extraction
Chromatography methods Gas chromatography, High performance liquid chromatography, Size exclusion chromatography, Principle, Basic instrumentation, Capillary Electrophoresis: Principle and application.

Thermoanalytical methods Thermogravimetry, Differential thermal analysis, differential scanning calorimetry, Principle, Block diagram, Applications, Quantitative determinations.

Electroanalytical methods Coulometric methods, Polarography, Pulse voltammetric methods, Amperometry, Principles, Applications, Electrochemical sensors, Ion selective, Potentiometric and amperometric sensors, Applications.

Spectroscopic methods Molecular absorption, Woodward rules, applications, Infra red absorption, functional group analysis, qualitative analysis, 1H- and 13C-NMR spectroscopy, Principle, Basic instrumentation, terminology, Interpretation of data, Quantitative applications.
Mass spectrometry Principles, Instrumentation, Ionization techniques, Characterization and applications.

Reading:

1. Mendham, Denny, Barnesand Thomas, Vogel: Text book of Quantitative Chemical Analysis, Pearson Education, 6th Edition, 2007.
2. Skoog, Holler and Kouch, Thomson, Instrumental methods of chemical analysis, 2007.
3. Willard, Meritt and Dean, Instrumental methods of chemical analysis, PHI, 2005.

CY391	CHEMICAL ASPECTS OF ENERGY SYSTEMS	OPC	3 – 0 – 0	3 Credits

Pre-requisites: None.

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

CO1	Understand traditional and alternative forms of energy
CO2	Understand energy production, storage, distribution and utilization.
CO3	Model environmental impacts of energy generation and conservation
CO4	Apply concepts of engineering design to energy challenges

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	-	-	-	-	-	-	1	-
CO2	-	-	-	-	-	-	1	-
CO3	-	-	-	-	-	-	1	-
CO4	-	-	-	-	-	-	1	-

Detailed Syllabus:

Thermo chemistry and chemical kinetics of energy sources: Chemistry of Fuels and Characteristics of a Good Fuel; Heats of Combustion of Fuels; Determination of Heats of Combustion by Bomb Calorimetry and Differential Scanning Calorimetry; Thermodynamics of Electrochemical Cells; Determination of Various Thermochemical Functions of Energy Materials by Electroanalytical Methods (Potentiometry, Coulometry and Voltammetry), Rates of Combustion Processes; Determination of Ignition Point, Flash Point and Other Kinetic Parameters of Chemical Energy Sources

Chemistry of Conventional and Non-Conventional energy materials: Chemical Composition of Finite Energy materials (Petroleum Products, Petroleum Refinery, Fractional Distillation and Petroleum Cracking; Natural Gas, Water Gas, Biomass and Goober Gas; Hydrogen as a Fuel and Its Controlled Combustion; Coal Carbonization and Gasification; Pulverization of Cellulose and Firewood

Electrochemical energy systems:Primary and Secondary batteries, Reserve batteries, Solid state and molten solvent batteries, Recent technological trends, Lithium ion batteries, Nanostructured electrode materials, Lithium and carbon based nanomaterials and nanocomposites, Solid-state Lithium ion batteries, Energy storage and backup. Fuel cells, Scientific prospects of fuel cells, Electrochemistry, In-situ and ex-situ electrochemical characterizations, Current-Voltage measurement, Current Interrupt measurements, Porosity, BET surface area analysis, Gas permeability, Hydrogen as future fuel, Alkaline-, acid- and molten carbonate-fuel cells, Solid oxide fuel cells.

Solar energy harnessing:Fundamentals, Conversion into electrical energy, Photovoltaic and Photogalvanic energy storage, Semiconductor photoelectrochemical cells, Photoelectrochemical reactions, Regenerative photoelectrochemical cells, Basic problems, Photocorrosion and protection of semiconductor electrodes, Protective coatings, Coatings of metals and electrically conductive polymers, Electrodes with chemically modified surfaces.

Photochemical and photoelectrochemical cleavage of water: Photochemistry and Photocatalysis of Splitting of Water Molecule; Chemically Modified Electrodes for Water Cleavage; Coordination Chemistry of Water Cleavage

Environmental concerns and green methods of energy sources: Quality of Chemical Energy Sources; Pollution Control and Monitoring of Energy Extraction from Materials; Nanochemical Methods in Energy Extraction; Modeling of Combustion and Other Energy Tapping from Materials

Reading:

1. Energy systems Engineering – Evaluation and Implementation, Francis Vanek, Louis Albright, Largus Argenent, Mc Graw-Hill, 2012.
2. Energy Systems and Sustainability: Power for a Sustainable Future, Bob Everett, Godfrey Boyle, Stephen Peake and Janet Ramage, Oxford Uni Press, 2012.
3. Lithium ion batteries – Advances and applications, Gianfranco Pistoria, Elsevier 2014.
4. Tomorrow's Energy: Hydrogen, Fuel cells, and the prospects for a cleaner planet, Peter Hoffmann, Byron Dorgan, MIT Press, 2012.
5. solar energy conversion Yuri V Pleskov, Springer-Verlag, 1990.
6. Solar energy conversion – Dynamics of interfacidal electron and excitation transfer, Piotrowiak, Laurie Peter, Heinz Frei and Tim Zhao, RSC 2013.

HS390	SOFT SKILLS	OPC	3 – 0 – 0	3 Credits

Pre-requisites: None.

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

CO1	Understand corporate communication culture
CO2	Prepare business reports and proposals expected of a corporate professional
CO3	Employ appropriate speech in formal business situations
CO4	Exhibit corporate social responsibility and ethics
CO5	Acquire corporate email, mobile and telephone etiquette

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	-	-	-	-	-	-	1	1
CO2	-	-	-	-	-	-	1	1
CO3	-	-	-	-	-	-	1	1
CO4	-	-	-	-	-	-	1	1
CO5	-	-	-	-	-	-	1	1

Detailed Syllabus:

English Language Enhancement: Verbs and tenses, Phrasal verbs, Synonyms, Antonyms, Homonyms - Descriptive Words, Combining Sentences, Business Idioms, Indianisms in English.

Art of Communication, Communication process- Non-verbal Communication- Effective Listening.

Interpersonal and Intra Personal Communication Skills- Self-Awareness- Self-Esteem and Confidence- Assertiveness and Confidence- Dealing with Emotions-Team Concept- Elements of Teamwork- Stages of Team Formation- Effective Team-Team Player Styles-Leadership.

Campus to Company- Dressing and Grooming- The Corporate Fit- Business Etiquette- Communication; media etiquette- Group Discussions, Interviews, and Presentation Skills.

Interview Handling skills- Effective Resume-- Common Interview Mistakes- Body-language- Content Aid, Visual Aids- Entrepreneurial Skills Development.

Reading:

1. Robert M. Sherfield, Developing Soft Skills, Montgomery and Moody Fourth Edn. Pearson, 2009.
2. K.Alex, Soft Skills: Know Yourself & Know The world, S. Chand; 2009.
3. Robert Bramson, Coping with Difficult People, Dell, 2009

CE440	BUILDING TECHNOLOGY	OPC	3 – 0 – 0	3 Credits

(This course is not offered to civil engineering students)

Pre-requisites: None.

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

CO1	Apply basic principles to develop stable, sustainable and cost-effective building plans.
CO2	Identify effective measures for fire proofing, damp proofing, and thermal insulation.
CO3	Adopt standard building provisions for natural ventilation and lighting.
CO4	Identify different materials, quality and methods of fabrication & construction.

Detailed Syllabus:

Overview of the course, basic definitions, Buildings – Types, components, economy and design, Principles of planning of buildings and their importance.

Definitions and importance of Grouping and circulation; Lighting and ventilation; How to consider these aspects during planning of building

Termite proofing: Inspection, control measures and precautions, Lighting protection of buildings: General principles of design of openings, Various types of fire protection measures to be considered while planning a building.

General requirements and extra requirements for safety against fire, special precautions, Vertical transportation in building – types of vertical transportation, Stairs, different forms of stairs, planning of stair cases, Other modes of vertical transportation – lifts, ramps, escalators.

Prefabrication systems in residential buildings – walls, openings, cupboards, shelves etc., planning and modules and sizes of components in prefabrication.

Planning and designing of residential buildings against the earthquake forces, Principles, Seismic forces and their effect on buildings.

Air conditioning – process and classification of air conditioning, Dehumidification. Systems of air-conditioning, ventilation, functional requirements of ventilation.

Acoustics, effect of noise, properties of noise and its measurements, Principles of acoustics of building. Sound insulation – importance and measures.

Plumbing services – water supply system, maintenance of building pipe line, Sanitary fittings, principles governing design of building drainage.

Reading:

1. Building Construction - Varghese, PHI Learning Private Limited, 2008

2. Building Construction - Punmia, B C, Jain, A J and Jain A J, Laxmi Publications, 2005.

3. Building Construction by S.P. Arora and S.P. Bindra – Dhanpatrai and Sons, New Delhi, 1996.

4. Building Construction – Technical Teachers Training Institute, Madras, Tata McGraw Hill, 1992.

5. National Building code of India, Bureau of Indian Standards, 2005.

EE 440	**NEW VENTURE CREATION**	**OPC**	**3–0– 0**	**3 Credits**

Pre-requisites: None

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

CO1	Understand the process and practice of entrepreneurship and new venture creation
CO2	Understand conceptual frameworks for identifying entrepreneurial opportunities and for preparation of business plan
CO3	Explore opportunities for launching a new venture

CO4	Identify functional management issues of running a new venture

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	-	1	2	1	1	-	1	1
CO2	-	1	1	1	1	-	1	1
CO3	-	-	-	-	1	-	1	1
CO4	-	-	-	-	1	-	1	1

Detailed syllabus:

Entrepreneur and entrepreneurship: Entrepreneurship and Small Scale Enterprises (SSE) – Role in Economic Development, Entrepreneurial Competencies, Institution Interface for SSE.

Establishing the small scale enterprise: Opportunity Scanning and Identification, Market Assessment for SSE, Choice of Technology and Selection of Site, Financing the New/Small Enterprises, Preparation of the Business Plan, Ownership Structures and Organizational Framework.

Operating the small scale enterprises: Financial Management Issues in SSE, Operational Management Issues in SSE, Marketing Management Issues in SSE, Organizational Relations in SSE.

Reading:

1. Kuratko: New Venture Management : The Entrepreneur's Roadmap, Pearson Education India, 2008.
2. Holt, "Entrepreneurship: New Venture Creation", PHI(P), Ltd.,2001.
3. Lisa K. Gundry, Jill R. Kickul: Entrepreneurship Strategy: Changing Patterns in New Venture Creation, Growth, and Reinvention, Sage Publications, 2007.

ME440	**ALTERNATIVE SOURCES OF ENERGY**	**OPC**	**3 – 0 – 0**	**3 Credits**

Pre-requisites: None

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

CO1	Identify renewable energy sources and their utilization.

CO2	Understand basic concepts of solar radiation and analyze solar thermal systems for its utilization.
CO3	Understand working of solar cells and its modern manufacturing technologies.
CO4	Understand concepts of Fuel cells and their applications
CO5	Identify methods of energy storage.
CO6	Compare energy utilization from wind energy, geothermal energy, biomass, biogas and hydrogen.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	1	-	-	-	-	1	1	1
CO2	1	-	-	-	-	1	1	1
CO3	1	-	-	-	-	-	1	1
CO4	1	-	-	-	-	-	1	1
CO5	1	-	-	-	-	-	1	1
CO6	1	-	-	-	-	-	1	1

Detailed Syllabus:

Introduction: Overview of the course; Examination and Evaluation patterns; Global warming; Introduction to Renewable Energy Technologies

Energy Storage: Introduction; Necessity of Energy Storage; Energy Storage Methods

Solar Energy: Fundamentals; Solar Radiation; Estimation of solar radiation on horizontal and inclined surfaces; Measurement of solar radiation data

Solar Thermal systems: Introduction; Basics of thermodynamics and heat transfer; Flat plate collector; Evacuated Tubular Collector; Solar air collector; Solar concentrator; Solar distillation; Solar cooker; Solar refrigeration and air conditioning; Thermal energy storage systems

Solar Photovoltaic systems: Introduction; Solar cell Fundamentals; Characteristics and classification; Solar cell: Module, panel and Array construction; Photovoltaic thermal systems.

Wind Energy: Introduction; Origin and nature of winds; Wind turbine siting; Basics of fluid mechanics; Wind turbine aerodynamics; wind turbine types and their construction; Wind energy conversion systems

Fuel cells: Overview; Classification of fuel cells; operating principles; Fuel cell thermodynamics

Biomass Energy: Introduction; Photosynthesis Process; Biofuels; Biomass Resources; Biomass conversion technologies; Urban waste to energy conversion; Biomass gasification.

Other forms of Energy: Introduction: Nuclear, ocean and geothermal energy applications; Origin and their types; Working principles

Reading:

1. Sukhatme S.P. and J.K.Nayak, Solar Energy - Principles of Thermal Collection and Storage, Tata McGraw Hill, New Delhi, 2008.
2. Khan B.H., Non-Conventional Energy Resources,Tata McGraw Hill, New Delhi, 2006.
3. J.A. Duffie and W.A. Beckman, Solar Energy - Thermal Pro

EC440	ELECTRONIC MEASUREMENTS AND INSTRUMENTAION	OPC	3 – 0 – 0	3 Credits

Pre-requisites: None

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

CO1	Apply knowledge of instruments for effective use
CO2	Select suitable instruments for typical measurements.
CO3	Identify various transducers to measure strain, temperature and displacement.
CO4	Understand data acquisition system and general purpose interfacing bus.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	-	2	-	-	-	-	1	-
CO2	-	2	-	-	-	-	1	-
CO3	-	2	-	-	-	-	1	-
CO4	-	2	-	-	-	-	1	-

Detailed syllabus

Measurement And Error: Sensitivity, Resolution, Accuracy and precision, Absolute and Relative types of errors, Statistical analysis, Probability of and Limiting errors, Linearity.

Instruments: D'Arsonval movement and basic principles of Measurement of Voltage, Current and Resistance in instruments. Analog and Digital Multimeters, Measurement of time and Frequency – Digital Frequency Meter and applications.

Impedance Measurement: Kelvin Bridge; Megger; Maxwell, Hay and Shering Bridges. Q-meter; Noise and Interference reduction techniques in Measurement Systems.

Oscilloscopes: Block diagram, probes, Deflection amplifier and delay line, Trigger Generator, Coupling, Automatic Time Base and Dual Trace Oscilloscopes, Pulse Measurements, Delayed Time Base, Analog Storage, Sampling and Digital Storage Oscilloscopes.

Special instruments: Wave Analyzer, Harmonic Distortion Analyzer, Spectrum Analyzer, FFT Analyzer.

Transducers (Qualitative Treatment Only): Classification and selection of Transducers, Introduction to strain, Load, force, Displacement, Velocity, Acceleration, Pressure and Temperature Measurements.

Introduction to Data Acquisition Systems (DAS): Block Diagram, Specifications and various components of DAS.

General purpose Instrumentation Bus (GP-IB): Protocol, SCPI Commands and Applications to DSO and DMM.

Reading:

1. Oliver and Cage, Electronic Measurements and Instrumentation, McGraw Hill, 2009
2. Helfrick Albert D. and Cooper William D., Electronic Instrumentation & Measurement Techniques, PHI, 2008.
3. D.A. Bell, Electronic Instrumentation and Measurements, 3/e, Oxford, 2013.

MM440	MATERIALS FOR ENGINEERING APPLICATIONS	OPC	3 – 0 – 0	3 Credits

Pre-requisites: None

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

CO1	Correlate processing, microstructure and properties of materials.
CO2	Understand behaviour of materials under various conditions.
CO3	Characterize modes of failure of engineering materials and design new materials with better properties and cost effective processes.
CO4	Identify suitable materials for engineering applications.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	-	1	2	-	1	-	1	1
CO2	-	-	2	-	1	-	1	1
CO3	-	-	2	-	1	-	1	1
CO4	-	-	2	-	1	-	1	1

Detailed Syllabus:

Materials Science and Engineering Materials, Classification of Materials and Properties: Mechanical, Dielectric, Magnetic and Thermal

Metallurgical Aspects of Materials: Structure of Metals and Alloys, Nature of Metallic Bonding, Crystal Structures of Metals, Structure of Alloys, Imperfections in Crystals, Significance of microstructural features

Heat Treatment: effect of cooling and heating rates and ageing materials for mechanical load bearing applications

Corrosion Resistant Materials: Some important Metals, Alloys, Ceramics and Polymers

Materials for Electrical Applications: Conductors, Dielectrics, insulators

Materials for Civil Engineering Applications

Materials for Biomedical applications: Steels, Ti and its alloys, Ni-Ti alloys, bioceramics, porous ceramics, bioactive glasses, calcium phosphates, collagen, thin films, grafts and coatings, biological functional materials Latex products

Reading:

1. M.F. Ashby: Engineering Materials, 4th Edition, Elsevier, 2005.
2. M.F. Ashby: Materials Selection in Mechanical Design, B H, 2005.
3. ASM Publication Vol. 20, Materials Selection and Design, ASM, 1997

4. Pat L. Mangonon: The Principles of Materials Selection and Design, PHI, 1999.

CH440	INDUSTRIAL POLLUTION CONTROL	OPC	3 – 0 – 0	3 Credits

Pre-requisites: None

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

CO1	Analyze the effects of pollutants on the environment.
CO2	Understand meteorological aspects of air pollution
CO3	Understand air pollution control methods
CO4	Select treatment technologies for water/wastewater/solid waste.
CO5	Design unit operations for pollution control.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	2	-	-	2	-	-	1	1
CO2	1	-	-	1	-	-	1	1
CO3	1	-	-	1	2	-	1	1
CO4	1	-	-	3	-	-	1	1
CO5	1	-	-	-	3	-	1	1

Detailed Syllabus:

Introduction: Biosphere, hydrological cycle, nutrient cycle, consequences of population growth, pollution of air, water and soil.

Air pollution sources & effects: Classification and properties of air pollutants, emission sources, behavior and fate of air pollutants, effect of air pollution.

Meteorological aspects of air pollutant dispersion: Temperature lapse rates and stability, wind velocity and turbulence, plume behavior, dispersion of air pollutants, estimation of plume rise.

Air pollution sampling and measurement: Types of pollutant sampling and measurement, ambient air sampling, stack sampling, analysis of air pollutants.

Air pollution control methods & equipment: Control methods, source correction methods, cleaning of gaseous effluents, particulate emission control, selection of a particulate collector, control of gaseous emissions, design methods for control equipment.

Water pollution: Water resources, origin of wastewater, types of water pollutants and there effects.

Waste water sampling, Analysis and Treatment: Sampling, methods of analysis, determination of organic matter, determination of inorganic substances, physical characteristics, bacteriological

measurement, basic processes of water treatment, primary treatment, secondary treatment, advanced wastewater treatment, recovery of materials from process effluents.

Solid Waste Management: Sources and classification, public health aspects, methods of collection, disposal Methods, potential methods of disposal.

Hazardous Waste Management: Definition and sources, hazardous waste classification, treatment methods, disposal methods.

Reading:

1. Rao C.S. – Environmental Pollution Control Engineering- Wiley Eastern Limited, India, 1993.
2. Noel de Nevers- Air Pollution and Control Engineering- McGraw Hill, 2000.
3. Glynn Henry J. and Gary W. Heinke - Environmental Science and Engineering, 2nd Edition, Prentice Hall of India, 2004.
4. Rao M.N. and Rao H.V.N - Air Pollution, Tata – McGraw Hill Publishing Ltd., 1993.
5. De A.K - Environmental Chemistry, Tata – McGraw Hill Publishing Ltd., 1999.

CH441	FUEL CELL TECHNOLOGY	OPC	3 – 0 – 0	3 Credits

Pre-requisites: None.
Course Outcomes: At the end of the course the student will be able to:

CO1	Understand fuel cell fundamentals.
CO2	Analyze the performance of fuel cell systems.
CO3	Understand construction and operation of fuel cell stack and fuel cell system.
CO4	Apply the modeling techniques for fuel cell systems

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	-	-	-	-	-	-	1	-
CO2	-	-	-	-	-	-	1	-
CO3	-	-	-	-	2	-	1	-
CO4	-	-	-	-	-	-	1	-

Detailed syllabus

Overview of Fuel Cells: What is a fuel cell, brief history, classification, how does it work, why do we need fuel cells, Fuel cell basic chemistry and thermodynamics, heat of reaction, theoretical electrical work and potential, theoretical fuel cell efficiency.

Fuels for Fuel Cells: Hydrogen, Hydrocarbon fuels, effect of impurities such as CO, S and others.

Fuel cell electrochemistry: electrode kinetics, types of voltage losses, polarization curve, fuel cell efficiency, Tafel equation, exchange currents.

Fuel cell process design: Main PEM fuel cell components, materials, properties and processes: membrane, electrode, gas diffusion layer, bi-polar plates, Fuel cell operating conditions: pressure, temperature, flow rates, humidity.

Main components of solid-oxide fuel cells, Cell stack and designs, Electrode polarization, testing of electrodes, cells and short stacks, Cell, stack and system modeling

Fuel processing: Direct and in-direct internal reforming, Reformation of hydrocarbons by steam, CO_2 and partial oxidation, Direct electro-catalytic oxidation of hydrocarbons,

carbon decomposition, Sulphur tolerance and removal , Using renewable fuels for SOFCs

Reading:

1. Gregor Hoogers, Fuel Cell Technology Hand Book, CRC Press, 2003.
2. Karl Kordesch& Gunter Simader, Fuel Cells and Their Applications, VCH Publishers, NY, 2001.
3. F. Barbir, PEM Fuel Cells: Theory and Practice (2nd Ed.) Elsevier/Academic Press, 2013.
4. Subhash C. Singal and Kevin Kendall, High Temperature Fuel Cells: Fundamentals, Design and Applications

CS440	Management Information Systems	OPC	3 – 0 – 0	3 Credits

Pre-requisites: None

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

CO1	Determine key terminologies and concepts including IT, marketing, management, economics, accounting, finance in the major areas of business.
CO2	Design, develop and implement Information Technology solutions for business problems.
CO3	Analysis of computing systems and telecommunication networks for business information systems.
CO4	Understand ethical issues that occur in business, evaluate alternative courses of actions and evaluate the implications of those actions.
CO5	Plan projects, work in team settings and deliver project outcomes in time.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	-	-	-	-	1	-	1	1
CO2	-	-	-	-	-	-	1	1
CO3	-	-	-	-	1	-	1	1
CO4	-	-	-	-	-	-	1	1
CO5	-	-	-	-	-	-	1	1

Detailed syllabus

Organization and Information Systems, Foundation Concepts, Information Systems in Business, The Components of Information Systems, Competing with Information Technology, Fundamentals of Strategic Advantage, Using Information Technology for Strategic Advantage.

Changing Environment and its impact on Business, Kinds of Information Systems.

Computer Fundamentals, Computer Hardware, Computer Systems: End User and Enterprise Computing, Computer Peripherals: Input, Output, and Storage Technologies, Computer Software, Application Software, System Software, Computer System Management, Data Resource Management, Technical Foundations of Database Management, Managing Data Resources

Telecommunication and Networks, Telecommunications and Networks, The Networked Enterprise, Telecommunications Network Alternatives

System Analysis and Development and Models, Developing Business/IT Strategies, Planning Fundamentals, Implementation Challenges, Developing Business/IT Solutions, Developing Business Systems, Implementing Business Systems

Manufacturing and Service Systems Information systems for Accounting, Finance, Production and Manufacturing, Marketing and HRM functions, Enterprise Resources Planning (ERP), Choice of IT, Nature of IT decision, Managing Information Technology, Managing Global IT,

Security and Ethical Challenges, Security and Ethical Challenges, Security and Ethical, and Societal Challenges of IT, Security Management of Information Technology, Enterprise and Global Management of Information Technology

Reading:

1. Kenneth J Laudon, Jane P. Laudon, *Management Information Systems*, 10th Edition, Pearson/PHI, 2007.
2. W. S. Jawadekar, *Management Information Systems*, 3rd Edition, TMH, 2004.

BT440	BIOSENSORS	OPC	3 – 0 – 0	3 Credits

Pre-requisites: None.

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

CO1	Understand biosensing and transducing techniques
CO2	Understand principles of linking cell components and biological pathways with energy transduction, sensing and detection
CO3	Demonstrate appreciation for the technical limits of performance of biosensor
CO4	Apply principles of engineering to develop bioanalytical devices and design of biosensors

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	1	1	-	-	-	-	1	1
CO2	-	-	-	-	-	-	1	1
CO3	-	-	-	-	-	-	1	1
CO4	-	-	-	-	-	-	1	1

Detailed Syllabus:

General principles: A historical perspective; Signal transduction; Physico-chemical and biological transducers; Sensor types and technologies, Definitions and Concepts Terminology and working vocabulary; Main technical definitions: calibration, selectivity, sensitivity, reproducibility, detection limits, response time.

Physico-chemical transducers: Electrochemical transducers (amperometric, potentiometric, conductimetric); optical transducers (absorption, fluorescence, SPR); Thermal transducers; Piezoelectric transducers.

Biorecognition systems: Enzymes; Oligonucleotides and Nucleic Acids; Lipids (Langmuir-Blodgett bilayers, Phospholipids, Liposomes); Membrane receptors and transporters; Tissue and organelles (animal and plant tissue); Cell culture; Immunoreceptors; Chemoreceptors; Limitations & problems. Immobilization of biomolecules.

Biosensor Engineering: Methods for biosensors fabrication: self-assembled monolayers, screen printing, photolithography, micro-contact printing, MEMS. Engineering concepts for mass production.

Application of modern sensor technologies: Clinical chemistry; Test-strips for glucose monitoring; Urea determination; Implantable sensors for long-term monitoring; Environmental monitoring; Technological process control; Food quality control; Forensic science benefits; Problems & limitations.

Reading:

1. Donald G. Buerk, Biosensors: Theory and Applications, 1st Edition, CRC Press, 2009.
2. Alice Cunningham, Introduction to Bioanalytical Sensors, John Wiley& Sons, 1998.
3. Brian R. Eggins, Chemical Sensors and Biosensors, John Wiley& Sons, 2003.

SM440	HUMAN RESOURCE MANAGEMENT	OPC	3 – 0 – 0	3 Credits

Pre-requisites: None

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

CO1	Understand principles, processes and practices of human resource management.
CO2	Apply HR concepts and techniques in strategic planning to improve organizational performance.
CO3	Understand tools to manage HR systems and procedures.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	-	-	-	-	1	-	-	-
CO2	-	-	-	-	1	-	-	-
CO3	-	-	-	-	1	-	-	-

Detailed Syllabus:

Introduction to Human Resource Management, Objectives, Scope and Significance of HRM, Functions of HRM, Problems and Prospects in HRM, Environmental scanning.

Human Resource Planning, Demand Forecasting Techniques, Supply Forecasting Techniques,
Analyzing work and designing jobs, Recruitment and Selection, Interviewing Candidates.

Human Resource Development, Orientation, Training and Development, Management Development, Performance Appraisal and Employee Compensation, Factors Influencing Employee Remuneration and Challenges of Remuneration.

Industrial Relations, Industrial Disputes and Discipline, Managing Ethical Issues in Human Resource Management, Workers Participation in Management, Employee safety and health, Managing Global Human Resources and Trade Unions

International HRM, Future of HRM and Human Resource Information Systems

Reading:

1. Aswathappa, Human Resource Management — TMH., 2010.
2. Garry Dessler and Biju Varkkey ,Human Resource Management, PEA., 2011.

3. Noe & Raymond ,HRM: Gaining a Competitive Advantage, TMH, 2008.
4. Bohlander George W, Snell Scott A, Human Resource Management, Cengage Learning, 2009.

MA440	OPTIMIZATION TECHNIQUES	OPC	3 – 0 – 0	3 Credits

Pre-requisites: None

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

CO1	Formulate and solve linear Programming Problems
CO2	Determine the optimum solution to constrained and unconstrained
CO3	Apply dynamic programming principle to Linear programming problems.
CO4	Determine the integer solutions to Linear Programming Problems.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	-	-	-	2	1	1	-	1
CO2	-	-	-	2	1	1	-	1
CO3	-	-	-	2	1	1	-	1
CO4	-	-	-	2	1	1	-	1

Detailed Syllabus:

Linear Programming: Introduction and formulation of models, Convexity, Simplex method, Big-M method, Two-phase method, Degeneracy, non-existent and unbounded solutions, revised simplex method, duality in LPP, dual simplex method, sensitivity analysis, transportation and assignment problems, traveling salesman problem .

Nonlinear Programming: Introduction and formulation of models, Classical optimization methods, equality and inequality constraints, Lagrange multipliers and Kuhn-Tucker conditions, quadratic forms, quadratic programming problem, Wolfe's method.

Dynamic Programming: Principle of optimality, recursive relations, solution of LPP.

Integer Linear Programming: Gomory's cutting plane method, Branch and bound algorithm, Knapsack problem, linear 0-1 problem.

Reading:

1. Kanti Swarup, Man Mohan and P.K.Gupta, Introduction to Operations Research, S.Chand & Co., 2006
2. J.C. Pant, Introduction to Operations Research, Jain Brothers, New Delhi, 2008.
3. N.S.Kambo, Mathematical Programming Techniques, East-West Pub., Delhi, 1991.

MA441	OPERATIONS RESEARCH	OPC	3 – 0 – 0	3 Credits

Prerequisites: None

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

CO1	Formulate and solve linear programming problems
CO2	Determine optimum solution to transportation problem
CO3	Determine average queue length and waiting times of queuing models.
CO4	Determine optimum inventory and cost in inventory models.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	-	-	-	2	1	1	-	1
CO2	-	-	-	2	1	1	-	1
CO3	-	-	-	2	1	1	-	1
CO4	-	-	-	2	1	1	-	1

Detailed Syllabus:

Linear Programming: Formulation and graphical solution of LPP's. The general LPP, slack, surplus and artificial variables. Reduction of a LPP to the standard form. Simplex computational procedure, Big-M method, Two-phase method. Solution in case of unrestricted variables. Dual linear programming problem. Solution of the primal problem from the solution of the dual problems.

Transportation Problems : Balanced and unbalanced Transportation problems. Initial basic feasible solution using N-W corner rule, row minimum method, column minimum, least cost entry method and Vogel's approximation method. Optimal solutions. Degenracy in Transportation problems.

Queueing Theory : Poisson process and exponential distribution. Poisson queues - Model (M/M/1):(∞/FIFO) and its characteristics.

Elements of Inventory Control : Economic lot size problems - Fundamental problems of EOQ. The problem of EOQ with finite rate of replenishment. Problems of EOQ with shortages - production instantaneous, replenishment of the inventory with finite rate. Stochastic problems with uniform demand (discrete case only).

Reading:

1. Kanti Swarup, Man Mohan and P.K.Gupta, Introduction to Operations Research, S. Chand & Co., 2006
2. J.C. Pant, Introduction to Operations Research, Jain Brothers, New Delhi, 2008.

3. N.S.Kambo : Mathematical Programming Techniques, East-West Pub., Delhi, 1991.

PH440	NANOMATERIALS AND TECHNOLOGY	OPC	3 – 0 – 0	3 Credits

Prerequisites: None

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

CO1	Understand synthesis and properties of nanostructured materials.
CO2	Analyze magnetic and electronic properties of quantum dots
CO3	Understand structure, properties and applications of Fullerenes and Carbon nanotubes.
CO4	Understand applications of nanoparticles in nanobiology and nanomedicine

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	1	-	1	1	1	-	1	1
CO2	1	-	1	1	1	-	1	1
CO3	1	-	1	1	1	-	1	1
CO4	1	-	1	1	1	-	1	1

Detailed Syllabus:

General properties of Nano materials : Origin of nanotechnology. Classification of nanomaterials. Fullerene,carbon, Nanotubes (CNT's), Nanoparticles. Physical, Chemical, Electrical, Optical, Magnetic and mechanical properties of nanomaterials.

Fullerenes and Carbon Nanotubes (CNT's): Introduction: Synthesis and purification. Preparation of fullerenes in the condensed phase,Transport, mechanical, physical properties of CNT's.

Investigation and manipulating materials in the Nanoscale: Electron microscope, scanning probe microscopes, optical microscopes for Nanoscience and Technology, X-Ray Diffraction.

SAMs and clusters: Growth process. Patterning monolayers. Types of clusters. Bonding and properties of clusters.

Semi conducting Quantum Dots: Introduction: Synthesis of Quantum Dots. Electronic structure of Nanocrystals, properties.

Nanobiology: Interaction between Biomolecules and Nanoparticle surgaces. Different types of Inorganic materials used for the synthesis of Hybrid Nano-bio assemblies. Nanoprobes for Analytical Applications.

Nanosensors: Nanosensors based on optical properties. Nanosensors based on quantum size effects. Nanobiosensors.

Nanomedicines: Developments of nanomedicines. Nanotechnology in Diagnostic Applications, materials for use in Diagnostic and therapeutic Applications.

Reading:

1. T. Pradeep, Nano: The Essentials; Tata McGraw-Hill, 2008.
2. W.R. Fahrner, Nanotechnology and Nanoelectronics; Springer,2006.
3. Rechard Booker and Earl Boysen, Nanotechnology, Willey, 2006.

PH441	BIOMATERIALS AND TECHNOLOGY	OPC	3 – 0 – 0	3 Credits

Prerequisites: None

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

CO1	Understand the structure and properties of biomaterials
CO2	Classify implant biomaterials
CO3	Evaluate biocompatibility of implants
CO4	Identify appropriate biomaterials for specific medical applications

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	1	-	1	-	-	-	1	-
CO2	1	-	1	-	-	-	1	-
CO3	1	-	1	-	-	-	1	-
CO4	1	-	1	-	-	-	1	-

Detailed Syllabus:

Overview of biomaterials: Historical developments, impact of biomaterials, interfacial phenomena, tissue responses to implants.

Structure and properties of biomaterials: Crystal structure of solids, phase changes, imperfections in solids, non-crystalline solids, surface properties of solids, mechanical properties, surface improvements.

Types of biomaterials: Metallic implant materials, ceramic implant materials, polymeric implant materials composites as biomaterials.

Characterization of materials: Electric properties, optical properties, X-ray absorption, acoustic and ultrasonic properties.

Bio implantation materials: Materials in ophthalmology, orthopedic implants, dental materials and cardiovascular implant materials.

Tissue response to implants : Normal wound healing processes, body response to implants, blood compatibility, structure – property relationship of tissues.

Reading:

1. Joon Park, R.S. Lakes , Biomaterials an introduction; 3rd Ed., Springer, 2007
2. Sujatha V Bhat , Biomaterials; 2nd Ed., Narosa Publishing House, 2006.

CY440	CORROSION SCIENCE	OPC	3 – 0 – 0	3 Credits

Pre-requisites: None

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

CO1	Understand the electrochemical Principles of Corrosion.
CO2	Apply eight forms of corrosion to industrial problems.
CO3	Evaluate corrosion rates for industrial problems
CO4	Evaluate the corrosion rates of steel in RCC under corrosive environments.
CO5	Perform case studies using microbially induced corrosion of metals.
CO6	Perform case studies using appropriate methods of corrosion control of metals and alloys

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	1	-	1	-	-	-	1	-
CO2	1	-	1	-	-	-	1	-
CO3	1	-	1	-	-	-	1	-
CO4	1	-	1	-	-	-	1	-
CO5	1	-	1	-	-	-	1	-
CO6	1	-	1	-	-	-	1	-

Detailed Syllabus:

Understanding Corrosion: Types of corrosion: uniform corrosion, Galvanic corrosion, pitting corrosion, stress corrosion cracking, corrosion fatigue, stray current corrosion, selective leaching, microbial corrosion, Pourbaix potential-pH diagrams for iron, for aluminium, limitations of Pourbaix diagram Passivity- characteristics of passivation and the Flade potential, Theories of passivity, passive-active cells, critical pitting potential, Anodic protection and transpassivity.

Methods of corrosion monitoring: Polarisation and corrosion rates, polarisation diagrams of corroding metals, calculation of corrosion rates from polarization data. Electrochemical impedance spectroscopy: Nyquist plots, Bode plots, simple equivalent circuits for fitting the impedance data, calculation of corrosion parameters from impedance measurements. Electrochemical cell assembly for polarization and impedance studies. Gravimetric method of determination of corrosion rates.

Measurement of corrosion rates of carbon steel in reinforced cement concrete, Corrosion rates of metals due to micriobially induced corrosion.

Methods of corrosion prevention and control:

Cathodic protection; By impressed current, By the use of sacrificial anodes, combined use with coatings, Advances in cathodic protection.

Metallic coatings: Methods of application, Electroplating, Electroless plating, specific metal platings like Cu, Ni and Cr.

Inhibitors and passivators: Picking inhibitors, vapour phase inhibitors, Inhibitors for cooling water systems, understanding of action of inhibitors through polarization and impedance.

Corrosion prevention and control strategies in different industries – case studies

Reading:

1. R. Winston Revie, Herbert H. Uhlig, Corrosion and Corrosion control, 4th edition, Wiley-Interscience, 2007
2. Mc Cafferty and Edward, Introduction to Corrosion Science, 1st Edition, Springer, 2010.
3. Mars G. Fontana, Corrosion Engineering, 3rd edition, Tata McGraw- Hill, New Delhi, 2008.

CY441	CHEMISTRY OF NANOMATERIALS	OPC	3 – 0 – 0	3 Credits

Pre-requisites: None

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

CO1	Understand the state of art synthesis of nano materials
CO2	Characterize nano materials using ion beam, scanning probe methodologies, position sensitive atom probe and spectroscopic ellipsometry.
CO3	Analyze nanoscale structure in metals, polymers and ceramics
CO4	Analyze structure-property relationship in coarser scale structures
CO5	Understand structures of carbon nano tubes.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	1	-	1	-	-	-	1	1
CO2	1	-	1	-	-	-	1	1
CO3	1	-	1	-	-	-	1	1
CO4	1	-	1	-	-	-	1	1
CO5	1	-	1	-	-	-	1	1

Detailed Syllabus:

Introduction: Scope of Nano science and nanotechnology, Nano science in nature, classification of nanostructured materials, importance of nano materials.

Synthetic Methods: Chemical Routes (Bottom-Up approach):- Sol-gel synthesis, micro emulsions or reverse micelles, solvothermal synthesis, microwave heating synthesis and sonochemical synthesis. Physical methods (Top-Down approach):- Inert gas condensation, plasma arc technique, ion sputtering, Laser ablation, laser pyrolysis, and chemical vapour deposition method.

Techniques for characterization:

Diffraction Technique: - Powder X-ray diffraction for particle size analysis.

Spectroscopy Techniques: - Operational principle and applications of spectroscopy techniques for the analysis of nanomaterials, UV-VIS spectrophotometers and its application for band gap measurement.

Electron Microscopy Techniques:- Scanning electron microscopy (SEM) and EDAX analysis, transmission electron microscopy (TEM), scanning probe microscopy (SPM).

BET method for surface area determination.

Dynamic light scattering technique for particle size analysis.

Reading:

4. T. Pradeep, NANO: The Essentials: McGraw-Hill, 2007.
5. B. S. Murty, P. Shankar, Baldev Rai, BB Rath and James Murday, Textbook of Nanoscience and nanotechnology: Univ. Press, 2012.
6. Guozhong Cao, Nanostructures & Nanomaterials; Synthesis, Properties & Applications: Imperial College Press, 2007.
7. M.A. Shah and Tokeer Ahmad, Principles of Nanoscience and Nanotechnology: Narosa Pub., 2010.
8. Manasi Karkare, Nanotechnology: Fundamentals and Applications: IK International, 2008.
9. C. N. R. Rao, Achim Muller, K.Cheetham, Nanomaterials Chemistry, Wiley-VCH, 2007

HS440	CORPORATE COMMUNICATION	OPC	3 – 0 – 0	3 Credits

Pre-requisites: None

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

CO1	Understand corporate communication culture
CO2	Prepare business letters, memos and reports
CO3	Communicate effectively in formal business situations
CO4	Exhibit corporate social responsibility and ethics
CO5	Practice corporate email, mobile and telephone etiquette
CO6	Develop good listening skills and leadership qualities

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	-	-	-	-	-	-	1	-
CO2	-	-	-	-	-	-	1	-
CO3	-	-	-	-	-	-	1	-
CO4	-	-	-	-	-	-	1	-
CO5	-	-	-	-	-	-	1	-
CO6	-	-	-	-	-	-	1	-

Detailed Syllabus:

Importance of Corporate communication - Introduction to and definition of corporates – Communication, process, patterns and channels of communication- Barriers to communication and strategies to overcome them- Evolution of corporate culture- Role and contribution of individual group and organization - Role of psychology in communication.

Oral Communication- Techniques for improving oral fluency-Speech mechanics-Group Dynamics and Group Discussion – Debate and oral presentations.

Written Communication- Types and purposes- Writing business reports, and business proposals- Memos, minutes of meetings- Circulars, persuasive letters- Letters of complaint- ; language and formats used for drafting different forms of communication. Internal and external communication.

Corporate responsibility- Circulating to employees vision and mission statements- ethical practices- Human rights -Labour rights-Environment- governance- Moral and ethical debates surrounding -Public Relations - Building trust with stakeholders.

Corporate Ethics and Business Etiquette- Integrity in communication-Harmful practices and communication breakdown- Teaching how to deal with tough clients through soft skills. Body language- Grooming- Introducing oneself- Use of polite language- Avoiding grapevine and card pushing – Etiquette in e-mail, mobile and telephone.

Listening Skills - Listening- for information and content- Kinds of listening- Factors affecting listening and techniques to overcome them- retention of facts, data and figures- Role of speaker in listening.

Leadership Communication Styles - Business leadership -Aspects of leadership-qualities of leader- training for leadership-delegation of powers and ways to do it-humour-commitment.

Reading:

1. Raymond V. Lesikar, John D. Pettit, Marie E. Flatley Lesikar's Basic Business Communication - 7th Edition: Irwin, 1993
2. Krishna Mohanand Meera Banerji, Developing Communication Skills: Macmillan Publishers India, 2000
3. R.C. Sharma & Krishna Mohan Business Correspondence and Report Writing: – 3rd Edition Tata McGraw-Hill, 2008
4. Antony Jay & Ross Jay, Effective Presentation, University Press, 1999.
5. Shirley Taylor, Communication for Business, Longman, 1999