CE - COURSE STRUCTURE

I Year I Semester

S. No.	Course Code	Name of Course / Laboratory	No. of Periods per week			No. of Credits
			L	T	P	
1	PH4501	Engineering Physics	3	0	0	3
2	MA4501	Linear Algebra & Calculus	3	0	0	3
3	EE4501	Basic Electrical & Electronics Engineering	3	0	0	3
4	ME4501	Engineering Graphics	1	0	4	3
5	CT4501	Introduction to Programming	3	0	0	3
6	PH4502	Engineering Physics Lab	0	0	2	1
7	EE4502	Electrical & Electronics Engineering Workshop	0	0	3	1.5
8	CT4502	Computer Programming Lab	0	0	3	1.5
9	CT4503	IT Workshop	0	0	2	1
10	NS4501	NSS/NCC/Scouts & Guides/Community Service	-	-	1	0.5
Total			**13**	**0**	**15**	**20.5**

I Year II Semester

S. No.	Course Code	Name of Course / Laboratory	No. of Periods per week			No. of Credits
			L	T	P	
1	EG4501	Communicative English	2	0	0	2
2	CH4503	Engineering Chemistry	3	0	0	3
3	MA4502	Differential Equations & Vector Calculus	3	0	0	3
4	CM4501	Basic Civil & Mechanical Engineering	3	0	0	3
5	CE4501	Engineering Mechanics	3	0	0	3
6	EG4502	Communicative English Lab	0	0	2	1
7	CH4504	Engineering Chemistry Lab	0	0	2	1
8	CE4503	Engineering Mechanics & Building Practices Lab	0	0	3	1.5
9	ME4502	Engineering Workshop	0	0	3	1.5
10	HW4501	Health and Wellness, Yoga and Sports	-	-	1	0.5
Total			**14**	**0**	**11**	**19.5**

II Year I Semester

Sl. No.	Course Code	Name of Course / Laboratory	No. of Periods per week			No. of Credits
			L	T	P	
1	BA4501	Managerial Economics and Financial Analysis	2	0	0	2
2	CE4504	Surveying	3	0	0	3
3	CE4505	Strength of Materials	3	0	0	3
4	CE4506	Fluid Mechanics	3	0	0	3
5	CE4507	Surveying Lab	0	0	3	1.5
6	CE4508	Strength of Materials Lab	0	0	3	1.5
7	DT4501	Design Thinking & Innovation	1	0	2	2
8	CE4509	Building Planning and Drawing	0	1	2	2
9	EN4501	Environmental Science	2	0	0	-
Total			**14**	**1**	**10**	**18**

II Year II Semester

Sl. No.	Course Code	Name of Course / Laboratory	No. of Periods per week			No. of Credits
			L	T	P	
1	UH4501	Universal human values – understanding harmony and Ethical human conduct	2	1	0	3
2	MA4508	Numerical Techniques and Statistical Methods	3	0	0	3
3	CE4510	Engineering Geology	3	0	0	3
4	CE4511	Concrete Technology	3	0	0	3
5	CE4512	Structural Analysis	3	0	0	3
6	CE4513	Hydraulics & Hydraulic Machinery	3	0	0	3
7	CE4514	Concrete Technology Lab	0	0	3	1.5
8	CE4515	Engineering Geology lab	0	0	3	1.5
9	CE4516	Remote Sensing & Geographical Information Systems	0	1	2	2
10	CE4517	Building materials and Construction	3	0	0	-
Total			**20**	**2**	**8**	**23**

III Year I Semester

S. No.	Course Code	Name of Course / Laboratory	No. of Periods per week			No. of Credits
			L	T	P	
1	CE4518	Design and Drawing of Reinforced Concrete Structures**	3	0	0	3
2	CE4519	Engineering Hydrology	3	0	0	3
3	CE4520	Soil Mechanics	3	0	0	3
4	-	**Professional Elective – I** (see list of Professional Electives)	3	0	0	3
5	-	**Open Elective – I** (see list of Open Electives)	3	0	0	3
6	CE4527	Geotechnical Engineering lab	0	0	3	1.5
7	CE4528	Fluid Mechanics & Hydraulic Machines Lab	0	0	3	1.5
8	EE4518	Tinkering Lab	0	0	2	1
9	CE4529	Skills on Civil Engineering software (CAD & Revit)	0	1	2	2
10	CE4530	Community Service Internship	-	-	4	2
Total			**15**	**1**	**14**	**23**

** Project Based Theory Course

III Year II Semester

S. No.	Course Code	Name of Course / Laboratory	No. of Periods per week			No. of Credits
			L	T	P	
1	CE4531	Foundation Engineering	3	0	0	3
2	CE4532	Highway Engineering	3	0	0	3
3	CE4533	Environmental Engineering	3	0	0	3
4	-	**Professional Elective – II** (see list of Professional Electives)	3	0	0	3
5	-	**Professional Elective – III** (see list of Professional Electives)	3	0	0	3
6	-	**Open Elective – II** (see list of Open Electives)	3	0	0	3
7	CE4543	Highway Engineering Lab	0	0	3	1.5
8	CE4544	Environmental Engineering Lab	0	0	3	1.5
9	EG4503	Soft Skills	0	1	2	2
10	EG4504	Technical Paper Writing and IPR	2	0	0	-
Total			**19**	**1**	**8**	**23**

Professional Elective – I

CE4521 Advanced Structural Analysis
CE4522 Ground Improvement Techniques
CE4523 Construction Technology and Management
CE4524 Advanced Surveying Techniques
MOOCS

Professional Elective – II

CE4534 Finite Element Analysis
CE4535 Structural Repair and Rehabilitation Techniques
CE4536 Water Resources Engineering
DM4503 Artificial Intelligence and Machine Learning
MOOCS

Professional Elective – III

CE4537 Air Pollution and Control
CE4538 Project Economics and Financial Analysis
CE4539 Railways, Airports and Harbour Engineering
CE4540 Disaster Preparedness, Planning And Management
MOOCS

Open Elective – I

CE4525 Green Buildings
CE4526 Climate Change Impact On Eco-System

Open Elective – II

CE4541 Disaster Management
CE4542 Sustainability in Engineering Practices

Honors Degree Course Structure

Sl. No.	Course Code	Year & Sem.	Name of Course / Laboratory	No. of Periods per week			No. of Credits
				L	T	P	
1	HCE4501	III-I	Introduction to Earthquake Engineering	3	-	-	3
2	HCE4502	III-I	Computer Applications in Civil Engineering	-	-	3	1.5
3			MOOCs	-	-	-	3
4	HCE4503	III-II	Structural Dynamics	3	-	-	3
5	HCE4504	III-II	Structural Design Lab	-	-	3	1.5
6			MOOCs	-	-	-	3
7		IV-I					
8		IV-I					
Total							

ENGINEERING PHYSICS

(Common to All Branches)
I Year – I Semester

Lecture :3	Internal Marks : 30
Credits :3	External Marks : 70

Course Objectives

- To apply principles of wave optics for Engineering Applications
- To Analyze crystal parameters to investigate crystal Structures
- To Impart the knowledge of solid state materials with characteristic utility in various engineering applications

Course Outcomes

Upon successful completion of the course, the students will be able to

- Analyze the intensity variation of light due to polarization, interference and diffraction.
- Familiarize with the basics of crystals and their structures.
- Summarize various types of polarization of dielectrics and classify the magnetic materials.
- Explore the basic concepts of Quantum Mechanics and the Free electron theory of solids.
- Identify conductivity mechanism in semiconductors

UNIT – I: Wave Optics

Interference: Introduction - Principle of superposition –Interference of light - Interference in thin films (Reflection Geometry) & applications - Colours in thin films- Newton's Rings, Determination of wavelength and refractive index.

Diffraction: Introduction - Fresnel and Fraunhofer diffractions - Fraunhofer diffraction due to single slit, double slit & N-slits (Qualitative) – Diffraction Grating - Dispersive power and resolving power of Grating (Qualitative). Polarization: Introduction -Types of polarization - Polarization by reflection, refraction and Double refraction - Nicol's Prism -Half wave and Quarter wave plates.

UNIT – II: Crystallography and X-ray diffraction

Crystallography: Space lattice, Basis, Unit Cell and lattice parameters – Bravais Lattices – crystal systems (3D) – coordination number - packing fraction of SC, BCC & FCC - Miller indices – separation between successive (hkl) planes.

X-ray diffraction: Bragg's law - X-ray Diffractometer – crystal structure determination by Laue's and powder methods

UNIT – III: Dielectric and Magnetic Materials

Dielectric Materials: Introduction - Dielectric polarization - Dielectric polarizability, Susceptibility, Dielectric constant and Displacement Vector – Relation between the electric vectors - Types of polarizations- Electronic (Quantitative), Ionic (Quantitative) and Orientation polarizations (Qualitative) - Lorentz internal field - Clausius- Mossotti equation - complex dielectric constant – Frequency dependence of polarization – dielectric loss

Magnetic Materials: Introduction - Magnetic dipole moment - Magnetization-Magnetic susceptibility and permeability – Atomic origin of magnetism - Classification of magnetic

materials: Dia, para, Ferro, anti-ferro & Ferri magnetic materials - Domain concept for Ferromagnetism & Domain walls (Qualitative) - Hysteresis - soft and hard magnetic materials.

UNIT – IV: Quantum Mechanics and Free electron Theory

Quantum Mechanics: Dual nature of matter – Heisenberg's Uncertainty Principle – Significance and properties of wave function – Schrodinger's time independent and dependent wave equations– Particle in a one-dimensional infinite potential well.

Free Electron Theory: Classical free electron theory (Qualitative with discussion of merits and demerits) – Quantum free electron theory – electrical conductivity based on quantum free electron theory - Fermi-Dirac distribution - Density of states - Fermi energy

UNIT – V: Semiconductors

Semiconductors: Formation of energy bands – classification of crystalline solids - Intrinsic semiconductors: Density of charge carriers – Electrical conductivity – Fermi level – Extrinsic semiconductors: density of charge carriers – dependence of Fermi energy on carrier concentration and temperature - Drift and diffusion currents – Einstein's equation – Hall effect and its applications.

Text Books:

1. A Text book of Engineering Physics, M. N. Avadhanulu, P.G.Kshirsagar & TVS Arun
2. Murthy, S. Chand Publications, 11th Edition 2019.
3. Engineering Physics - D.K.Bhattacharya and Poonam Tandon, Oxford press (2015)

Reference Books:

1. Engineering Physics - B.K. Pandey and S. Chaturvedi, Cengage Learning 2021.
2. Engineering Physics - Shatendra Sharma, Jyotsna Sharma, Pearson Education, 2018.
3. Engineering Physics" - Sanjay D. Jain, D. Sahasrabudhe and Girish, University Press. 2010
4. Engineering Physics - M.R. Srinivasan, New Age international publishers (2009).

e-Learning Resources:

1. https://www.loc.gov/rr/scitech/selected-internet/physics.html

LINEAR ALGEBRA AND CALCULUS

(Common to All Branches)

I Year – I Semester

Lecture :3	Internal Marks : 30
Credits :3	External Marks : 70

Course Objectives

- To equip the students with standard concepts and tools at an intermediate to advanced level of mathematics to develop the confidence and ability among the students to handle various real-world problems and their applications.

Course Outcomes

Upon successful completion of the course, the students will be able to

- develop and use of matrix algebra techniques that are needed by engineers for practical applications.
- compute eigen values and eigenvectors of real matrices.
- utilize mean value theorems to real life problems.
- familiarize with functions of several variables, which are useful in optimization.
- measure areas and volumes using double and triple integrals.

Course Content

UNIT I Matrices

Rank of a matrix by Echelon form, Normal form. Cauchy–Binet formula (without proof). Inverse of non- singular matrices by Gauss-Jordan method, System of linear equations: Solving system of Homogeneous and Non-Homogeneous equations by Gauss elimination method, Jacobi and Gauss Seidel Iteration Methods.

UNIT II Eigenvalues, Eigenvectors and Orthogonal Transformation

Eigenvalues, Eigenvectors and their properties, Diagonalization of a matrix, Cayley-Hamilton Theorem (without proof), finding inverse and power of a matrix by Cayley-Hamilton Theorem, Quadratic forms and Nature of the Quadratic Forms, Reduction of Quadratic form to canonical form by Orthogonal Transformation.

UNIT III Calculus

Mean Value Theorems: Rolle's Theorem, Lagrange's mean value theorem with their geometrical interpretation, Cauchy's mean value theorem, Taylor's and Maclaurin's theorems with remainders (without proof), Problems and applications on the above theorems.

UNIT IV Partial differentiation and Applications (Multi variable calculus)

Functions of several variables: Continuity and Differentiability, Partial derivatives, total derivatives, chain rule, Taylor's and Maclaurin's series expansion of functions of two variables. Jacobians, Functional dependence, maxima and minima of functions of two variables, method of Lagrange multipliers.

UNIT V Multiple Integrals (Multi variable Calculus)

Double integrals, triple integrals, change of order of integration, change of variables to polar, cylindrical and spherical coordinates. Finding areas (by double integrals) and volumes (by double integrals and triple integrals).

Textbooks:

1. Higher Engineering Mathematics, B. S. Grewal, Khanna Publishers, 2017, 44th Edition
2. Advanced Engineering Mathematics, Erwin Kreyszig, John Wiley & Sons, 2018, 10th Edition.

Reference Books:

1. Thomas Calculus, George B.Thomas, Maurice D.Weir and Joel Hass, Pearson Publishers, 2018, 14th Edition.
2. Advanced Engineering Mathematics, R. K. Jain and S.R.K.Iyengar, Alpha Science International Ltd., 2021, 5th Edition(9th reprint)
3. Advanced Modern Engineering Mathematics, Glyn James, Pearson publishers, 2018, 5thEdition.
4. Advanced Engineering Mathematics, Micheael Greenberg, , Pearson publishers, 9thEdition
5. Higher Engineering Mathematics, H. K Das, Er.Rajnish Verma, S.Chand Publications, 2014, 3rd Edition (Reprint 2021)

BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

(Common to All Branches)

I Year – I Semester

Lecture :3	Internal Marks : 30
Credits :3	External Marks : 70

PART A: BASIC ELECTRICAL ENGINEERING

Course Objectives

To expose the students to the fundamentals of dc and ac circuits, electrical machines, measuring instruments, operation of various power generation systems, electricity bill and electrical safety measures.

Course Outcomes

Upon successful completion of the course, the students will be able to

- apply fundamental laws / concepts to derive various equations related to impedance, voltage, current and power in electrical circuits.
- describe the construction and working principles of electrical machines, measuring instruments and power generation stations.
- calculate the electrical load / electrical bill for domestic premises and explain the electrical safety measures.

UNIT I DC & AC Circuits

DC Circuits: Electrical circuit elements (R, L and C), Ohm's Law and its limitations, KCL & KVL, series, parallel, series-parallel circuits, Super Position theorem, Simple numerical problems.

AC Circuits: A.C. Fundamentals: Equation of AC Voltage and current, waveform, time period, frequency, amplitude, phase, phase difference, average value, RMS value, form factor, peak factor, Voltage and current relationship with phasor diagrams in R, L, and C circuits, Concept of Impedance, Active power, reactive power and apparent power, Concept of power factor (Simple Numerical problems).

UNIT II Machines and Measuring Instruments

Machines: Construction, principle and operation of (i) DC Motor, (ii) DC Generator, (iii) Single Phase Transformer, (iv) Three Phase Induction Motor and (v) Alternator, Applications of electrical machines.

Measuring Instruments: Construction and working principle of Permanent Magnet Moving Coil (PMMC), Moving Iron (MI) Instruments and Wheat Stone bridge.

UNIT III Energy Resources, Electricity Bill & Safety Measures

Energy Resources: Conventional and non-conventional energy resources; Layout and operation of various Power Generation systems: Hydel, Nuclear, Solar & Wind power generation.

Electricity bill: Power rating of household appliances including air conditioners, PCs, Laptops, Printers, etc. Definition of "unit" used for consumption of electrical energy, two-part electricity tariff, calculation of electricity bill for domestic consumers.

Equipment Safety Measures: Working principle of Fuse and Miniature circuit breaker(MCB), merits and demerits. Personal safety measures: Electric Shock, Earthing and its types, Safety Precautions to avoid shock.

Textbooks

1. Basic Electrical Engineering, D. C. Kulshreshtha, Tata McGraw Hill, 2019, First Edition
2. Power System Engineering, P.V. Gupta, M.L. Soni, U.S. Bhatnagar and A. Chakrabarti, Dhanpat Rai & Co, 2013
3. Fundamentals of Electrical Engineering, Rajendra Prasad, PHI publishers, 2014, Third Edition

Reference Books

1. Basic Electrical Engineering, D. P. Kothari and I. J. Nagrath, Mc Graw Hill, 2019, Fourth Edition
2. Principles of Power Systems, V.K. Mehtha, S.Chand Technical Publishers, 2020
3. Basic Electrical Engineering, T. K. Nagsarkar and M. S. Sukhija, Oxford University Press, 2017
4. Basic Electrical and Electronics Engineering, S. K. Bhatacharya, Person Publications, 2018, Second Edition.

Web Resources:

1. https://nptel.ac.in/courses/108105053
2. https://nptel.ac.in/courses/108108076

PART B: BASIC ELECTRONICS ENGINEERING

Course Objectives

To teach the fundamentals of semiconductor devices, basic electronic circuits and instrumentation and principles of digital electronics.

Course Outcomes

Upon successful completion of the course, the students will be able to

- expound the operation and characteristics of various diodes, transistors and amplifiers.
- describe the working of rectifiers, regulators, amplifiers with its frequency response, and electronic instrumentation system.
- explicate the various number systems, logic gates, simple combinational circuits and sequential circuits

UNIT – I: Semiconductor Devices

Introduction - Evolution of electronics – Vacuum tubes to nano electronics - Characteristics of PN Junction Diode — Zener Effect — Zener Diode and its Characteristics. Bipolar Junction Transistor — CB, CE, CC Configurations and Characteristics — Elementary Treatment of Small Signal CE Amplifier.

UNIT – II: Basic Electronic Circuits and Instrumentation

Rectifiers and power supplies: Block diagram description of a dc power supply, working of a full wave bridge rectifier, capacitor filter (no analysis), working of simple zener voltage regulator. Amplifiers: Block diagram of Public Address system, Circuit diagram and working of common emitter (RC coupled) amplifier with its frequency response. Electronic Instrumentation: Block diagram of an electronic instrumentation system.

UNIT – III: Digital Electronics

Overview of Number Systems, Logic gates including Universal Gates, BCD codes, Excess-3 code, Gray code, Hamming code. Boolean Algebra, Basic Theorems and properties of Boolean Algebra, Truth Tables and Functionality of Logic Gates – NOT, OR, AND, NOR, NAND, XOR and XNOR. Simple combinational circuits–Half and Full Adders. Introduction to sequential circuits, Flip flops, Registers and counters (Elementary Treatment only)

Text Books:

1. R. L. Boylestad & Louis Nashlesky, Electronic Devices & Circuit Theory, Pearson Education, 2021.
2. R. P. Jain, Modern Digital Electronics, 4th Edition, Tata Mc Graw Hill, 2009

Reference Books:

1. R. S. Sedha, A Textbook of Electronic Devices and Circuits, S. Chand & Co, 2010.
2. Santiram Kal, Basic Electronics- Devices, Circuits and IT Fundamentals, Prentice Hall, India, 2002.
3. R. T. Paynter, Introductory Electronic Devices & Circuits – Conventional Flow Version, Pearson Education,2009.

End examination pattern:

i) Question paper shall be in two parts viz., Part A and Part B with equal Weightage of 35marks each.

ii) In each part, question 1 shall contain 5 compulsory short answer questions for a total of 5 marks such that each question carries 1 mark.

iii) In each part, questions from 2 to 4, there shall be either/or type questions of 10 marks each. Student shall answer any one of them.

iv) The questions from 2 to 4 shall be set by covering one unit of the syllabus for each question.

ENGINEERING GRAPHICS

(Common to All Branches)

I Year – I Semester

Lecture :1	Practice :4	Internal Marks	: 30
Credits :3		External Marks	: 70

Course Objectives

- To impart basic knowledge and skills required to prepare engineering drawings

Course Outcomes

Upon successful completion of the course, the students will be able to

- demonstrate the ability to construct regular polygons and curves.
- develop various scales to accurately represent measurements on engineering drawings.
- prepare orthographic projections for points, lines and planes.
- create projections for solids.
- demonstrate the ability to section and develop surfaces for simple geometric shapes.
- construct orthographic views from isometric views and vice versa
- utilize computer graphics tools to create 2D and 3D drawings of objects.

UNIT I

Introduction: Lines, Lettering and Dimensioning, Geometrical Constructions and Constructing regular polygons by general methods.

Curves: construction of ellipse, parabolaand hyperbola by general, Cycloids, Involutes, Normal and tangent to Curves.

Scales: Plain scales, diagonal scales and vernier scales.

UNIT II

Orthographic Projections: Reference plane, importance of reference lines or Plane, Projections of a point situated in any one of the four quadrants.

Projections of Straight Lines: Projections of straight lines parallel to both reference planes, perpendicular to one reference plane and parallel to other reference plane, inclined to one reference plane and parallel to the other reference plane. Projections of Straight Line Inclined to both the reference planes

Projections of Planes: regular planes Perpendicular to both reference planes, parallel to one reference plane and inclined to the other reference plane; plane inclined to both the reference planes.

UNIT III

Projections of Solids: Types of solids: Polyhedra and Solids of revolution. Projections of solids in simple positions: Axis perpendicular to horizontal plane, Axis perpendicular to vertical plane and Axis parallel to both the reference planes, Projection of Solids with axis inclined to one reference plane and parallel to another plane.

UNIT IV

Sections of Solids: Perpendicular and inclined section planes, Sectional views and True shape of section, Sections of solids in simple position only.

Development of Surfaces: Methods of Development: Parallel line development and radial line development. Development of a cube, prism, cylinder, pyramid and cone.

UNITV

Conversion of Views: Conversion of isometric views to orthographic views; Conversion of orthographic views to isometric views.

Computer graphics: Creating 2D & 3D drawings of objects including PCB and Transformations using Auto CAD (Not for end examination).

Textbook:

1. N.D. Bhatt, Engineering Drawing, Charotar Publishing House, 2016.

Reference Books:

1. Engineering Drawing, K. L. Narayana and P. Kannaiah,Tata Mc Graw Hill, 2013.
2. Engineering Drawing, M. B. Shahand B.C.Rana, Pearson Education Inc, 2009.
3. Engineering Drawing with an Introduction to Auto CAD, Dhananjay Jolhe, Tata Mc Graw Hill, 2017.

INTRODUCTION TO PROGRAMMING

(Common to All Branches)

I Year – I Semester

Lecture :3	Internal Marks : 30
Credits :3	External Marks : 70

Course Objectives

- To foster logical thinking and problem – solving skills using programming.
- To familiarize students with programming concepts such as data types, control structures, functions, arrays and files.

Course Outcomes

Upon successful completion of the course, the students will be able to

- solve problems using the concepts of algorithm and algorithmic thinking.
- use control structures in programming for solving the problems
- apply the concepts of arrays and strings in problem solving.
- use pointers and user-defined data types in developing the programs
- write functions to increase the reusability of code and use various file handling functions for efficient handling of data.

Course Content

UNIT I: Introduction to Programming and Problem Solving

History of Computers, Basic organization of a computer: ALU, input-output units, memory, program counter, Introduction to Programming Languages, Basics of a Computer Program Algorithms, flowcharts (Using Dia Tool), pseudo code. Introduction to Compilation and Execution, Primitive Data Types, Variables, and Constants, Basic Input and Output, Operations, Type Conversion, and Casting.

Problem solving techniques: Algorithmic approach, characteristics of algorithm,
Problem solving strategies: Top-down approach, Bottom-up approach, Time and space complexities of algorithms.

UNIT II: Control Structures

Simple sequential programs Conditional Statements (if, if-else, switch), Loops (for, while, dowhile) Break and Continue.

UNIT III: Arrays and Strings

Arrays indexing, memory model, programs with array of integers, two dimensional arrays, Introduction to Strings.

UNIT IV: Pointers & User Defined Data types

Pointers, dereferencing and address operators, pointer and address arithmetic, array manipulation using pointers, User-defined data types-Structures and Unions.

UNIT V: Functions & File Handling

Introduction to Functions, Function Declaration and Definition, Function call Return Types and Arguments, modifying parameters inside functions using pointers, arrays as parameters. Scope and Lifetime of Variables, Basics of File Handling.

Textbooks

1. "The C Programming Language", Brian W. Kernighan and Dennis M. Ritchie, Prentice-Hall, 1988
2. Schaum's Outline of Programming with C, Byron S Gottfried, McGraw-Hill Education, 1996

Reference Books

1. Computing fundamentals and C Programming, Balagurusamy, E., McGraw-Hill Education, 2008.
2. Programming in C, Rema Theraja, Oxford, 2016, 2nd edition
3. C Programming, A Problem Solving Approach, Forouzan, Gilberg, Prasad, CENGAGE, 3rd edition

ENGINEERING PHYSICS LAB

(Common to All Branches)

I Year – I Semester

Practice :2	Internal Marks : 30
Credits :1	External Marks : 70

Course Objectives

To study the concepts of optical phenomenon like interference, diffraction etc., recognize the importance of energy gap in the study of conductivity and Hall effect in semiconductors and study the parameters and applications of dielectric and magnetic materials by conducting experiments.

Course Outcomes

Upon successful completion of the course, the students will be able to

- Operate optical instruments like travelling microscope and spectrometer.
- Estimate the wavelengths of different colours using diffraction grating.
- Plot the intensity of the magnetic field of circular coil carrying current with distance.
- Evaluate dielectric constant and magnetic susceptibility for dielectric and magnetic materials respectively.
- Calculate the band gap of a given semiconductor, Identify the type of semiconductor using Hall effect.
- Identify unknown frequency and verify laws of vibrations

List of Experiments:

1. Determination of radius of curvature of a given Plano-convex lens by Newton's rings.
2. Determination of wavelengths of different spectral lines in mercury spectrum using diffraction grating in normal incidence configuration.
3. Verification of Brewster's law
4. Determination of dielectric constant using charging and discharging method.
5. Study the variation of B versus H by magnetizing the magnetic material (B-H curve).
6. Determination of wavelength of Laser light using diffraction grating.
7. Estimation of Planck's constant using photoelectric effect.
8. Determination of the resistivity of semiconductors by four probe methods.
9. Determination of energy gap of a semiconductor using p-n junction diode.
10. Magnetic field along the axis of a current carrying circular coil by Stewart Gee's Method.
11. Determination of Hall voltage and Hall coefficient of a given semiconductor using Hall effect.
12. Determination of temperature coefficients of a thermistor.
13. Determination of acceleration due to gravity and radius of Gyration by using a compound pendulum.
14. Determination of magnetic susceptibility by Kundt's tube method.
15. Determination of rigidity modulus of the material of the given wire using Torsional pendulum.
16. Sonometer: Verification of laws of stretched string.
17. Determination of young's modulus for the given material of wooden scale by non-uniform bending (or double cantilever) method.
18. Determination of Frequency of electrically maintained tuning fork by Melde's experiment.

Note

- Any TEN of the listed experiments are to be conducted. Out of which any TWO experiments may be conducted in virtual mode.

References:

- A Textbook of Practical Physics - S. Balasubramanian, M.N. Srinivasan, S. Chand Publishers, 2017.

Web Resources

- www.vlab.co.in
- https://phet.colorado.edu/en/simulations/filter?subjects=physics&type=html,prototype

ELECTRICAL AND ELECTRONICS ENGINEERING WORKSHOP

(Common to All Branches)

I Year – I Semester

Practice :3	Internal Marks : 30
Credits :1.5	External Marks : 70

PART A: ELECTRICAL ENGINEERING LAB

Course Objectives

To impart knowledge on the fundamental laws & theorems of electrical circuits, characteristics of dc generator, measurement of resistance, earth resistance, power and power factor, and energy calculations.

Course Outcomes

Upon successful completion of the course, the students will be able to

- measure voltage, current, power and power factor in an electrical circuit.
- verify the superposition theorem.
- measure resistance and earth resistance using wheat stone bridge and megger respectively.
- determine critical field resistance and critical speed of dc shunt generator and compute the electrical energy for domestic premises.

Activities

1. Familiarization of commonly used Electrical & Electronic Workshop Tools: Bread board, Solder, cables, relays, switches, connectors, fuses, Cutter, plier, screwdriver set, wire stripper, flux, knife/blade, soldering iron, de-soldering pump etc.
    a. Provide some exercises so that hardware tools and instruments are learned to be used by the students.
2. Familiarization of Measuring Instruments like Voltmeters, Ammeters, multimeter, LCR-Q meter, Power Supplies, CRO, DSO, Function Generator, Frequency counter.
    a. Provide some exercises so that measuring instruments are learned to be used by thestudents.
3. Components:
    a. Familiarization/Identification of components (Resistors, Capacitors, Inductors, Diodes, transistors, IC's etc.) – Functionality, type, size, colour coding package, symbol, cost etc.
    b. Testing of components like Resistor, Capacitor, Diode, Transistor, ICs etc. - Compare values of components like resistors, inductors, capacitors etc with the measured values by using instruments

List of experiments

1. Verification of KCL and KVL
2. Verification of Superposition theorem
3. Measurement of Resistance using Wheat stone bridge
4. Magnetization Characteristics of DC shunt Generator
5. Measurement of Power and Power factor using Single-phase wattmeter
6. Measurement of Earth Resistance using Megger
7. Calculation of Electrical Energy for Domestic Premises

Reference Books

1. Basic Electrical Engineering, D. C. Kulshreshtha, Tata McGraw Hill, 2019, First Edition
2. Power System Engineering, P.V. Gupta, M.L. Soni, U.S. Bhatnagar and A. Chakrabarti, Dhanpat Rai & Co, 2013
3. Fundamentals of Electrical Engineering, Rajendra Prasad, PHI publishers, 2014, Third Edition

Note: Minimum Six Experiments to be performed.

PART – B ELECTRONICS ENGINEERING LAB

Course Objectives

- To impart knowledge on the principles of digital electronics and fundamentals of Electronic devices & their applications.

Course Outcomes

Upon successful completion of the course, the students will be able to

- Identify and test various electronic components and demonstrate the usage of electronic measuring instruments.
- Analyse the electrical behaviour of various electronic devices and digital logic circuits.
- Design and implementation of various electronic circuits for the given specifications.
- Test and verify the operation of electronic circuits using modern simulation tools.

List of Experiments

1. Plot V-I characteristics of PN Junction diode A) Forward bias B) Reverse bias.
2. Plot V – I characteristics of Zener Diode and its application as voltage Regulator.
3. Implementation of half wave and full wave rectifiers
4. Plot Input & Output characteristics of BJT in CE and CB configurations
5. Frequency response of CE amplifier.
6. Simulation of RC coupled amplifier with the design supplied
7. Verification of Truth Table of AND, OR, NOT, NAND, NOR, Ex-OR, Ex-NOR gates using ICs.
8. Verification of Truth Tables of S-R, J-K& D flip flops using respective ICs.

Tools / Equipment Required

- DC Power supplies, Multi meters, DC Ammeters, DC Voltmeters, AC Voltmeters, CROs, all the required active devices.

References

1. R. L. Boylestad& Louis Nashlesky, Electronic Devices & Circuit Theory, Pearson Education, 2021.
2. R. P. Jain, Modern Digital Electronics, 4th Edition, Tata Mc Graw Hill, 2009
3. R. T. Paynter, Introductory Electronic Devices & Circuits – Conventional Flow Version, Pearson Education,2009.

Note: Minimum Six Experiments to be performed. All the experiments shall be implemented using both Hardware and Software.

COMPUTER PROGRAMMING LAB

(Common to All Branches)

I Year – I Semester

Practice :3	Internal Marks : 15
Credits :1.5	External Marks : 35

Course Objectives

- To give students hands-on experience in problem solving and train them on the concepts of C –programming language.

Course Outcomes

Upon successful completion of the course, the students will be able to

- develop and trace the execution of programs written in C language.
- select the right control structure for solving the problem.
- develop C programs using structures and unions.
- develop, debug and execute programs to demonstrate the applications of arrays, functions and basic concepts of pointers in C.
- create and access files using file handling functions.

UNIT I WEEK 1

Objective: Getting familiar with the programming environment on the computer and writing the first program.

Suggested Experiments/Activities:

Tutorial 1: Problem-solving using Computers.

Lab1: Familiarization with programming environment

i) Basic Linux environment and its editors like Vi, Vim & Emacs etc.
ii) Exposure to Turbo C, gcc
iii) Writing simple programs using printf(), scanf()

WEEK 2

Objective: Getting familiar with how to formally describe a solution to a problem in a series of finite steps both using textual notation and graphic notation.

Suggested Experiments /Activities:

Tutorial 2: Problem-solving using Algorithms and Flow charts.

Lab 1: Converting algorithms/flow charts into C Source code.

Developing the algorithms/flowcharts for the following sample programs

i) Sum and average of 3 numbers
ii) Conversion of Fahrenheit to Celsius and vice versa
iii) Simple interest calculation

WEEK 3

Objective: Learn how to define variables with the desired data-type, initialize them with appropriate values and how arithmetic operators can be used with variables and constants.

Suggested Experiments/Activities:

Tutorial 3: Variable types and type conversions:

Lab 3: Simple computational problems using arithmetic expressions.

i) Finding the square root of a given number
ii) Finding compound interest
iii) Area of a triangle using heron's formulae
iv) Distance travelled by an object

UNIT II WEEK 4

Objective: Explore the full scope of expressions, type-compatibility of variables & constants and operators used in the expression and how operator precedence works.

Suggested Experiments/Activities:

Tutorial4: Operators and the precedence and as associativity:

Lab4: Simple computational problems using the operator' precedence and associativity

i) Evaluate the following expressions.
   a. A+B*C+(D*E) + F*G
   b. A/B*C-B+A*D/3
   c. A+++B---A
   d. J= (i++) + (++i)

ii) Find the maximum of three numbers using conditional operator

iii) Take marks of 5 subjects in integers, and find the total, average in float

WEEK 5

Objective: Explore the full scope of different variants of "if construct" namely if-else, nullelse, if-else if*-else, switch and nested-if including in what scenario each one of them can be used and how to use them. Explore all relational and logical operators while writing conditionals for "if construct".

Suggested Experiments/Activities:

Tutorial 5: Branching and logical expressions:

Lab 5: Problems involving if-then-else structures.

i) Write a C program to find the max and min of four numbers using if-else.

ii) Write a C program to generate electricity bill.

iii) Find the roots of the quadratic equation.

iv) Write a C program to simulate a calculator using switch case.

v) Write a C program to find the given year is a leap year or not.

WEEK 6

Objective: Explore the full scope of iterative constructs namely while loop, do-while loop and for loop in addition to structured jump constructs like break and continue including when each of these statements is more appropriate to use.

Suggested Experiments/Activities:

Tutorial 6: Loops, while and for loops

Lab 6: Iterative problems e.g., the sum of series

i) Find the factorial of given number using any loop.

ii) Find the given number is a prime or not.

iii) Compute sine and cos series

iv) Checking a number palindrome

v) Construct a pyramid of numbers.

UNIT III WEEK 7

Objective: Explore the full scope of Arrays construct namely defining and initializing 1-D and 2-D and more generically n-D arrays and referencing individual array elements from the defined array. Using integer 1-D arrays, explore search solution linear search.

Suggested Experiments/Activities:

Tutorial 7: 1 D Arrays: searching.

Lab 7:1D Array manipulation, linear search

i) Find the min and max of a 1-D integer array.

ii) Perform linear search on1D array.

iii) The reverse of a 1D integer array

iv) Find 2's complement of the given binary number.

v) Eliminate duplicate elements in an array.

WEEK 8

Objective: Explore the difference between other arrays and character arrays that can be used as Strings by using null character and get comfortable with string by doing experiments that will reverse a string and concatenate two strings. Explore sorting solution bubble sort using integer arrays.

Suggested Experiments/Activities:

Tutorial 8: 2 D arrays, sorting and Strings.

Lab 8: Matrix problems, String operations, Bubble sort

i) Addition of two matrices
ii) Multiplication two matrices
iii) Sort array elements using bubble sort
iv) Concatenate two strings without built-in functions
v) Reverse a string using built-in and without built-in string functions

UNIT IV WEEK 9

Objective: Explore pointers to manage a dynamic array of integers, including memory allocation & value initialization, resizing changing and reordering the contents of an array and memory de-allocation using malloc (), calloc (), realloc () and free () functions. Gain experience processing command-line arguments received by C Suggested Experiments/Activities:

Tutorial 9: Pointers, structures and dynamic memory allocation

Lab 9: Pointers and structures, memory dereference.

i) Write a C program to find the sum of a 1D array using malloc()
ii) Write a C program to find the total, average of n students using structures
iii) Enter n students data using calloc() and display failed students list
iv) Read student name and marks from the command line and display the student details along with the total.
v) Write a C program to implement realloc()

WEEK 10

Objective: Experiment with C Structures, Unions, bit fields and self-referential structures (Singly linked lists) and nested structures

Suggested Experiments/Activities:

Tutorial 10: Bitfields, Self-Referential Structures, Linked lists

Lab10 : Bitfields, linked lists Read and print a date using dd/mm/yyyy format using bit-fields and differentiate the same without using bit- fields

i) Create and display a singly linked list using self-referential structure.
ii) Demonstrate the differences between structures and unions using a C program.
iii) Write a C program to shift/rotate using bitfields.
iv) Write a C program to copy one structure variable to another structure of the same type.

UNIT V WEEK 11

Objective: Explore the Functions, sub-routines, scope and extent of variables, doing some experiments by parameter passing using call by value. Basic methods of numerical integration

Suggested Experiments/Activities:

Tutorial 11: Functions, call by value, scope and extent,

Lab 11: Simple functions using call by value, solving differential equations using Eulers theorem.

i) Write a C function to calculate NCR value.
ii) Write a C function to find the length of a string.
iii) Write a C function to transpose of a matrix.
iv) Write a C function to demonstrate numerical integration of differential equations using Euler's method

WEEK 12

Objective: Explore how recursive solutions can be programmed by writing recursive functions that can be invoked from the main by programming at-least five distinct problems that have naturally recursive solutions.

Suggested Experiments/Activities:

Tutorial 12: Recursion, the structure of recursive calls

Lab 12: Recursive functions

i) Write a recursive function to generate Fibonacci series.
ii) Write a recursive function to find the lcm of two numbers.
iii) Write a recursive function to find the factorial of a number.
iv) Write a C Program to implement Ackermann function using recursion.
v) Write a recursive function to find the sum of series.

WEEK 13

Objective: Explore the basic difference between normal and pointer variables, Arithmetic operations using pointers and passing variables to functions using pointers Suggested Experiments/Activities:

Tutorial 13: Call by reference, dangling pointers

Lab 13: Simple functions using Call by reference, Dangling pointers.

Write a C program to swap two numbers using call by reference.

i) Demonstrate Dangling pointer problem using a C program.
ii) Write a C program to copy one string into another using pointer.
iii) Write a C program to find no of lowercase, uppercase, digits and other characters using pointers.

WEEK14

Objective: To understand data files and file handling with various file I/O functions. Explore the differences between text and binary files.

Suggested Experiments/Activities:

Tutorial 14: File handling

Lab 14: File operations

i) Write a C program to write and read text into a file.
ii) Write a C program to write and read text into a binary file using fread() and fwrite()
iii) Copy the contents of one file to another file.
iv) Write a C program to merge two files into the third file using command-line arguments.
v) Find no. of lines, words and characters in a file
vi) Write a C program to print last n characters of a given file.

Textbooks

1. Ajay Mittal, Programming in C: A practical approach, Pearson.
2. Byron Gottfried, Schaums Outline of Programming with C, McGraw Hill

Reference Books

1. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, PrenticeHall of India.
2. C Programming, A Problem-Solving Approach, Forouzan, Gilberg, Prasad, CENGAGE.

IT WORKSHOP

(Common to All Branches)

I Year – I Semester

Practice :2	Internal Marks : 30
Credits :1	External Marks : 70

Course Objectives

- To introduce the internal parts of a computer, peripherals, I/O ports, connecting cables
- To demonstrate configuring the system as Dual boot both Windows and other Operating Systems Viz. Linux, BOSS.
- To teach basic command line interface commands on Linux.
- To teach the usage of Internet for productivity and self-paced life-long learning.
- To introduce Compression, Multimedia and Antivirus tools and Office Tools such as Word processors, Spread sheets and Presentation tools.

Course Outcomes

Upon successful completion of the course, the students will be able to

- Perform Hardware troubleshooting.
- Safeguard computer systems from viruses/worms.
- Prepare document/ Presentation on a given topic.
- Perform calculations using spreadsheets.
- Apply AI tools/Chat GPT to do search,creative writing and language translation.

PC Hardware & Software Installation

Task 1: Identify the peripherals of a computer, components in a CPU and its functions. Draw the block diagram of the CPU along with the configuration of each peripheral and submit to your instructor.

Task 2: Every student should disassemble and assemble the PC back to working condition. Lab instructors should verify the work and follow it up with a Viva. Also students need to go through the video which shows the process of assembling a PC. A video would be given as part of the course content.

Task 3: Every student should individually install MS windows on the personal computer. Lab instructor should verify the installation and follow it up with a Viva.

Task 4: Every student should install Linux on the computer. This computer should have windows installed. The system should be configured as dual boot (VMWare) with both Windows and Linux. Lab instructors should verify the installation and follow it up with a Viva

Task 5: Every student should install BOSS on the computer. The system should be configured as dual boot (VMWare) with both Windows and BOSS. Lab instructors should verify the installation and follow it up with a Viva

Internet & World Wide Web

Task1: Orientation & Connectivity Boot Camp: Students should get connected to their Local Area Network and access the Internet. In the process they configure the TCP/IP setting. Finally students should demonstrate, to the instructor, how to access the websites and email. If there is

no internet connectivity preparations need to be made by the instructors to simulate the WWW on the LAN.
Task 2: Web Browsers, Surfing the Web: Students customize their web browsers with the LAN proxy settings, bookmarks, search toolbars and pop up blockers. Also, plug-ins like Macromedia Flash and JRE for applets should be configured.

Task 3: Search Engines & Netiquette: Students should know what search engines are and how to use the search engines. A few topics would be given to the students for which they need to search on Google. This should be demonstrated to the instructors by the student.

Task 4: Cyber Hygiene: Students would be exposed to the various threats on the internet and would be asked to configure their computer to be safe on the internet. They need to customize their browsers to block pop ups, block active x downloads to avoid viruses and/or worms.

LaTeX and WORD

Task 1 Word Orientation: The mentor needs to give an overview of LaTeX and Microsoft (MS) office or equivalent (FOSS) tool word: Importance of LaTeX and MS office or equivalent (FOSS) tool Word as word Processors, Details of the four tasks and features that would be covered in each, Using LaTeX and word Accessing, overview of toolbars, saving files, Using help and resources, rulers, format painter in word.

Task 2: Using LaTeX and Word to create a project certificate. Features to be covered:- Formatting Fonts in word, Drop Cap in word, Applying Text effects, Using Character Spacing, Borders and Colors, Inserting Header and Footer, Using Date and Time option in both LaTeX and Word.

Task 3: Creating project abstract Features to be covered:-Formatting Styles, Inserting table, Bullets and Numbering, Changing Text Direction, Cell alignment, Footnote, Hyperlink, Symbols, Spell Check, Track Changes.

Task 4: Creating a Newsletter: Features to be covered:- Table of Content, Newspaper columns, Images from files and clip-art, Drawing toolbar and Word Art, Formatting Images, Textboxes, Paragraphs and Mail Merge in word.

EXCEL

Excel Orientation: The mentor needs to tell the importance of MS office or equivalent (FOSS) tool Excel as a Spreadsheet tool, give the details of the four tasks and features that would be covered in each. Using Excel Accessing, overview of toolbars, saving excel files, Using help and resources.
Task 1: Creating a Scheduler - Features to be covered: Grid-lines, Format Cells, Summation, auto fill, Formatting Text

Task 2: Calculating GPA -. Features to be covered:- Cell Referencing, Formulae in excel average, std. deviation, Charts, Renaming and Inserting worksheets, Hyper linking, Count function, LOOKUP/VLOOKUP.

Task 3: Split cells, freeze panes, group and outline, Sorting, Boolean and logical operators, Conditional formatting

POWER POINT

Task 1: Students will be working on basic power point utilities and tools which help them create basic power point presentations. PPT Orientation, Slide Layouts, Inserting Text, Word Art, Formatting Text, Bullets and Numbering, Auto Shapes, Lines and Arrows in PowerPoint.

Task 2: Interactive presentations - Hyperlinks, Inserting Images, Clip Art, Audio, Video, Objects, Tables and Charts.

Task 3: Master Layouts (slide, template, and notes), Types of views (basic, presentation, slide slotter, notes etc), and Inserting Background, textures, Design Templates, Hidden slides.

AI TOOLS ChatGPT

Task 1: Prompt Engineering: Experiment with different types of prompts to see how the model responds. Try asking questions, starting conversations, or even providing incomplete sentences to see how the model completes them.
Ex: Prompt: "You are a knowledgeable AI. Please answer the following question: What is the capital of France?"

Task 2: Creative Writing: Use the model as a writing assistant. Provide the beginning of a story or a description of a scene, and let the model generate the rest of the content. This can be a fun way to brainstorm creative ideas
Ex: Prompt: "In a world where gravity suddenly stopped working, people started floating upwards. Write a story about how society adapted to this new reality."

Task 3: Language Translation: Experiment with translation tasks by providing a sentence in one language and asking the model to translate it into another language. Compare the output to see how accurate and fluent the translations are.
Ex: Prompt: "Translate the following English sentence to French: 'Hello, how are you doing today?'"

Reference Books:

a. Comdex Information Technology course tool kit, Vikas Gupta, WILEY Dream tech, 2003
b. The Complete Computer upgrade and repair book, Cheryl A Schmidt, WILEY Dream tech, 2013, 3rd edition
c. Introduction to Information Technology, ITL Education Solutions limited, Pearson Education, 2012, 2nd edition
d. PC Hardware - A Handbook, Kate J. Chase, PHI (Microsoft)
e. LaTeX Companion, Leslie Lamport, PHI/Pearson.
f. IT Essentials PC Hardware and Software Companion Guide, David Anfins on and Ken Quamme, CISCO Press, Pearson Education, 3rd edition
g. IT Essentials PC Hardware and Software Labs and Study Guide, Patrick Regan CISCO Press, Pearson Education, 3rd edition

NSS/NCC/SCOUTS AND GUIDES /COMMUNITY SERVICE

(Common to All branches)

I Year – I Semester

Practical :1 Internal Marks : 100

Credits :0.5

Course Objectives

- The objective of introducing this course is to impart discipline, character, fraternity, teamwork, social consciousness among the students and engaging them in selfless service.

Course Outcomes

Upon successful completion of the course, the students will be able to

- understand the importance of discipline, character and service motto.
- solve some societal issues by applying acquired knowledge, facts, and techniques.
- **e**xplore human relationships by analyzing social problems.
- determine to extend their help for the fellow beings and downtrodden people.
- develop leadership skills and civic responsibilities.

Course Content

UNIT I Orientation

General Orientation on NSS/NCC/ Scouts & Guides/Community Service activities, career guidance.

Activities

i) Conducting –ice breaking sessions-expectations from the course-knowing personal talents and skills.
ii) Conducting orientations programs for the students –future plans-activities-releasing road map etc.
iii) Displaying success stories-motivational biopics- award winning movies on societal issues etc.
iv) Conducting talent show in singing patriotic songs-paintings- any other contribution.

UNIT II Nature & Care

Activities

i) Best out of waste competition.
ii) Poster and signs making competition to spread environmental awareness.
iii) Recycling and environmental pollution article writing competition.
iv) Organising Zero-waste day.
v) Digital Environmental awareness activity via various social media platforms.
vi) Virtual demonstration of different eco-friendly approaches for sustainable living.
vii) Write a summary on any book related to environmental issues.

UNIT III Community Service

Activities

i) Conducting One Day Special Camp in a village contacting village-area leaders- Survey in the village, identification of problems- helping them to solve via media- authorities-experts-etc.
ii) Conducting awareness programs on Health-related issues such as General Health, Mental health, Spiritual Health, HIV/AIDS.
iii) Conducting consumer Awareness. Explaining various legal provisions etc.
iv) Women Empowerment Programmes - Sexual Abuse, Adolescent Health and Population Education.
v) Any other programmes in collaboration with local charities, NGOs etc.

Reference Books

1. Nirmalya Kumar Sinha & Surajit Majumder, A Text Book of National Service Scheme Vol;.I, Vidya Kutir Publication, 2021 (ISBN 978-81-952368-8-6)
2. Red Book - National Cadet Corps – Standing Instructions Vol I & II, Directorate General of NCC, Ministry of Defence, New Delhi
3. Davis M. L. and Cornwell D. A., "Introduction to Environmental Engineering", McGraw Hill, New York 4/e 2008
4. Masters G. M., Joseph K. and Nagendran R. "Introduction to Environmental Engineering and Science", Pearson Education, New Delhi. 2/e 2007
5. Ram Ahuja. Social Problems in India, Rawat Publications, New Delhi.

General Guidelines

1. Institutes must assign slots in the Timetable for the activities.
2. Institutes are required to provide instructor to mentor the students.

Evaluation Guidelines

- Evaluated for a total of 100 marks.
- A student can select 6 activities of his/her choice with a minimum of 01 activity per unit. Each activity shall be evaluated by the concerned teacher for 15 marks, totalling to 90 marks.
- A student shall be evaluated by the concerned teacher for 10 marks by conducting viva voce on the subject.

COMMUNICATIVE ENGLISH

(Common to All Branches)

I Year – II Semester

Lecture :2	Internal Marks : 30
Credits :2	External Marks : 70

Course Objective

The main objective of introducing this course, Communicative English, is to facilitate effective Listening, Reading, Speaking and Writing skills among the students. It enhances the same in their comprehending abilities, oral presentations, reporting useful information and providing knowledge of grammatical structures and vocabulary. This course helps the students to make them effective in speaking and writing skills and to make them industry ready.

Course Outcomes

Upon successful completion of the course, the students will be able to

- Understand the context, topic, and pieces of information from social or Transactional dialogues.
- Apply grammatical structures to formulate sentences and correct word forms.
- Analyze discourse markers to speak clearly on a specific topic in informal discussions.
- Evaluate reading / listening texts and to write summaries based on global comprehension of the texts.
- Create a coherent paragraph, essay, and resume.

UNIT I

Lesson: HUMAN VALUES: Gift of Magi **(Short Story)**

Listening: Identifying the topic, the context and specific pieces of information by listeningto short audio texts and answering a series of questions.

Speaking: Asking and answering general questions on familiar topics such as home, family, work, studies and interests; introducing oneself and others.

Reading: Skimming to get the main idea of a text; scanning to look for specific pieces ofinformation.

Writing: Mechanics of Writing-Capitalization, Spellings, Punctuation-Parts of Sentences.

Grammar: Parts of Speech, Basic Sentence Structures-forming questions

Vocabulary: Synonyms, Antonyms, Affixes (Prefixes/Suffixes), Root words.

UNIT II

Lesson: NATURE: The Brook by Alfred Tennyson (Poem)

Listening: Answering a series of questions about main ideas and supporting ideas after listening to audio texts.

Speaking: Discussion in pairs/small groups on specific topics followed by short structuretalks.

Reading: Identifying sequence of ideas; recognizing verbal techniques that help to link the ideas in a paragraph together.

Writing: Structure of a paragraph - Paragraph writing (specific topics)

Grammar: Cohesive devices - linkers, use of articles and zero article; repositions.

Vocabulary: Homonyms, Homophones, Homographs.

UNIT III
Lesson: BIOGRAPHY: Elon Musk

Listening: Listening for global comprehension and summarizing what is listened to.
Speaking: Discussing specific topics in pairs or small groups and reporting what is discussed
Reading: Readinga text in detail by making basic inferences -recognizing and interpretingspecific context clues; strategies to use text clues for comprehension.
Writing: Summarizing, Note-making, paraphrasing
Grammar: Verbs - tenses; subject-verb agreement; Compound words, Collocations
Vocabulary: Compound words, Collocations

UNIT IV
Lesson: INSPIRATION: The Toys of Peace by Saki

Listening: Making predictions while listening to conversations/ transactional dialogues without video; listening with video.
Speaking: Role plays for practice of conversational English in academic contexts (formal and informal) - asking for and giving information/directions.
Reading: Studying the use of graphic elements in texts to convey information, reveal trends/patterns/relationships, communicate processes or display complicated data.
Writing: Letter Writing: Official Letters, Resumes
Grammar: Reporting verbs, Direct & Indirect speech, Active & Passive Voice
Vocabulary: Words often confused, Jargons

UNIT V
Lesson: MOTIVATION: The Power of Intrapersonal Communication (An Essay)

Listening: Identifying key terms, understanding concepts and answering a series of relevant questions that test comprehension.
Speaking: Formal oral presentations on topics from academic contexts
Reading: Reading comprehension.
Writing: Writing structured essays on specific topics.
Grammar: Editing short texts identifying and correcting common errors in grammar and usage (articles, prepositions, tenses, subject verb agreement)
Vocabulary: Technical Jargons

Textbooks:

1. Pathfinder: Communicative English for Undergraduate Students, 1st Edition, OrientBlack Swan, 2023
2. **Extensive Reading (for internal assessment only)**

   The following simplified classics, one for each mid-semester, from the series, *Great Stories in Easy English*, published by S. Chand & Company Limited:

   - *Kidnapped* by R L Stevenson
   - *Little Women* by Louisa May Alcott

Reference Books:

1. Dubey, Sham Ji & Co. English for Engineers, Vikas Publishers, 2020
2. Bailey, Stephen. Academic writing: A Handbook for International Students. Routledge,2014.
3. Murphy, Raymond. English Grammar in Use, Fourth Edition, Cambridge UniversityPress, 2019.
4. Lewis, Norman. Word Power Made Easy- The Complete Handbook for Building aSuperior Vocabulary. Anchor, 2014.

Web Resources:

GRAMMAR:

1. www.bbc.co.uk/learningenglish
2. https://dictionary.cambridge.org/grammar/british-grammar/
3. www.eslpod.com/index.html
4. https://www.learngrammar.net/
5. https://english4today.com/english-grammar-online-with-quizzes/
6. https://www.talkenglish.com/grammar/grammar.aspx

VOCABULARY

1. https://www.youtube.com/c/DailyVideoVocabulary/videos
2. https://www.youtube.com/channel/UC4cmBAit8i_NJZE8qK8sfpA

ENGINEERING CHEMISTRY

(Common to CE & ME)

I Year – II Semester

Lecture :3	Internal Marks : 30
Credits :3	External Marks : 70

Course Objectives

- To impart the knowledge of water treatment methods, electrochemical energy systems, corrosion and its prevention.
- To impart the knowledge of fuels, modern engineering materials and lubricants.

Course Outcomes

Upon successful completion of the course, the students will be able to

- solve the numerical problems on hardness of water and explain water treatment methods and their significance in industry and daily life.
- solve the numerical problems on emf and identify the electrochemistry involved in batteries; analyze the corrosion of metals and suggest a suitable method for its prevention.
- analyze the quality of fuels and explain the applications of polymers.
- explain the properties and applications of modern engineering materials.
- identify the applications of adsorption, colloids and nano materials.

UNIT-I: Water Technology

Soft and hardwater, Estimation of hardness of water by EDTA Method, Estimation of dissolved Oxygen - Boiler troubles –Priming, foaming, scale and sludge, Caustic embrittlement, Industrial water treatment – Specifications for drinking water, Bureau of Indian Standards(BIS) and World health organization(WHO) standards, Ion-exchange processes - desalination of brackish water, reverse osmosis (RO) and electrodialysis.

UNIT-II: Electrochemistry and Applications

Electrodes –electrochemical cell, Nernst equation, cell potential calculations.

Primary cells – Zinc-air battery, Secondary cells – Nickel-Cadmium (NiCad),and lithium ion batteries- working principle of the batteries including cell reactions; Fuel cells-Basic Concepts, the principle and working of hydrogen-oxygen Fuel cell.

Corrosion: Introduction to corrosion, electrochemical theory of corrosion, differential aeration cell corrosion, galvanic corrosion, metal oxide formation by dry electrochemical corrosion, Pilling Bedworth ratios and uses, Factors affecting the corrosion, cathodic and anodic protection, electroplating and electro less plating (Nickel and Copper).

UNIT-III: Polymers and Fuel Chemistry

Introduction to polymers, functionality of monomers, Mechanism of chain growth, step growth polymerization.

Thermoplastics and Thermo-setting plastics-: Preparation, properties and applications of poly styrene. PVC Nylon 6,6 and Bakelite.

Elastomers – Preparation, properties and applications of Buna S, Buna N, Thiokol rubbers. Fuels – Types of fuels, calorific value of fuels, numerical problems based on calorific value; Analysis of coal (Proximate and Ultimate analysis), Liquid Fuels, refining of petroleum, Octane and Cetane number- alternative fuels- propane, methanol, ethanol and bio fuel-bio diesel.

UNIT- IV: Modern Engineering Materials

Composites- Definition, Constituents, Classification- Particle, Fibre and Structural reinforced composites, properties and Engineering applications

Refractories- Classification, Properties, Factors affecting the refractory materials and Applications.

Lubricants- Classification, Functions of lubricants, Mechanism, Properties of lubricating oils – Viscosity, Viscosity Index, Flash point, Fire point, Cloud point, saponification and Applications.

Building materials- Portland Cement, constituents, Setting and Hardening of cement.

UNIT-V: Surface Chemistry and Nanomaterials

Introduction to surface chemistry, colloids, nanometals and nanometal oxides, micelle formation, synthesis of colloids (Braggs Method), chemical and biological methods of preparation of nanometals and metal oxides, stabilization of colloids and nanomaterials by stabilizing agents, adsorption isotherm (Freundlich and Longmuir), BET equation (no derivation) applications of colloids and nanomaterials – catalysis, medicine, sensors, etc.

Textbooks

1. Jain and Jain, Engineering Chemistry, 16/e, Dhanpat Rai, 2013.
2. Peter Atkins, Julio de Paula and James Keeler, Atkins' Physical Chemistry, 10/e, Oxford University Press, 2010.

Reference Books:

1. H.F.W. Taylor, Cement Chemistry, 2/e, Thomas Telford Publications, 1997.
2. D.J.Shaw, Introduction to Colloids and Surface Chemistry Butterworth- Heineman, 1992.
3. Textbook of Polymer Science, Fred W. Billmayer Jr, 3rd Edition

DIFFERENTIAL EQUATIONS AND VECTOR CALCULUS

(Common to All Branches)

I Year – II Semester

Lecture :3	Internal Marks : 30
Credits :3	External Marks : 70

Course Objectives

- To enlighten the learners in the concept of differential equations and multivariable calculus.
- To furnish the learners with basic concepts and techniques at plus two level to lead them into advanced level by handling various real-world applications.

Course Outcomes

Upon successful completion of the course, the students will be able to

- solve the first order differential equations related to various engineering fields.
- find the solutions of higher order linear differential equations.
- identify solution methods for partial differential equations that model physical processes.
- interpret the physical meaning of different operators such as gradient, curl and divergence.
- estimate the work done against a field, circulation and flux using vector calculus also verify the relation between line, surface and volume integrals using integral theorems.

UNIT I Differential equations of first order and first degree

Linear differential equations – Bernoulli's equations- Exact equations and equations reducible to exact form. Applications: Newton's Law of cooling – Law of natural growth and decay- Electrical circuits.

UNIT II Linear differential equations of higher order (Constant Coefficients)

Definitions, homogeneous and non-homogeneous, complimentary function, general solution, particular integral, Wronskian, Method of variation of parameters. Simultaneous linear equations, applications to L-C-R Circuit problems and Simple Harmonic motion.

UNIT III Partial Differential Equations

Introduction and formation of Partial Differential Equations by elimination of arbitrary constants and arbitrary functions, solutions of first order linear equations using Lagrange's method. Homogeneous Linear Partial differential equations with constant coefficients.

UNIT IV Vector differentiation

Scalar and vector point functions, vector operator Del, Del applies to scalar point functions-Gradient, Directional derivative, Del applied to vector point functions-Divergence and Curl, vector identities.

UNIT V Vector integration

Line integral-circulation-work done, surface integral-flux, Green's theorem in the plane (without proof), Stoke's theorem (without proof), volume integral, Divergence theorem (without proof) and related problems.

Textbooks

1. Higher Engineering Mathematics, B. S. Grewal, Khanna Publishers, 2017, 44th Edition
2. Advanced Engineering Mathematics, Erwin Kreyszig, John Wiley & Sons, 2018, 10th Edition.

Reference Books

1. Thomas Calculus, George B. Thomas, Maurice D. Weir and Joel Hass, Pearson Publishers, 2018, 14th Edition.
2. Advanced Engineering Mathematics, Dennis G. Zill and Warren S. Wright, Jones and Bartlett, 2018.
3. Advanced Modern Engineering Mathematics, Glyn James, Pearson publishers, 2018,5th Edition.
4. Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Alpha Science International Ltd., 2021 5th Edition (9th reprint).
5. Higher Engineering Mathematics, B. V. Ramana, , McGraw Hill Education, 2017

BASIC CIVIL AND MECHANICAL ENGINEERING

(Common to All Branches)

I Year – II Semester

Lecture :3	Internal Marks : 30
Credits :3	External Marks : 70

PART A: BASIC CIVIL ENGINEERING

Course Objectives

- Get familiarized with the scope and importance of Civil Engineering sub-divisions.
- Introduce the preliminary concepts of surveying.
- Acquire preliminary knowledge on Transportation and its importance in nation's economy.
- Get familiarized with the importance of quality, conveyance and storage of water.
- Introduction to basic civil engineering materials and construction techniques.

Course Outcomes

Upon successful completion of the course, the students will be able to

- Gain knowledge on various sub-divisions of Civil Engineering and to appreciate their role in ensuring better society
- Apply the concepts of surveying and to determine the distances, angles and levels
- Realize the importance of Water Storage & Conveyance Structures, Transportation and Environmental Engineering in Nation's economy

UNIT I

Basics of Civil Engineering: Role of Civil Engineers in Society- Various Disciplines of Civil Engineering- Structural Engineering- Geo-technical Engineering- Transportation Engineering - Hydraulics and Water Resources Engineering - Environmental Engineering-Scope of each discipline - Building Construction and Planning- Construction Materials-Cement - Aggregate - Bricks- Cement concrete- Steel. Introduction to Prefabricated construction Techniques.

UNIT II

Surveying: Objectives of Surveying- Horizontal Measurements- Angular Measurements- Introduction to Bearings Levelling instruments used for levelling -Simple problems on levelling and bearings-Contour mapping.

UNIT III

Transportation Engineering Importance of Transportation in Nation's economic development- Types of Highway Pavements- Flexible Pavements and Rigid Pavements - Simple Differences. Basics of Harbour, Tunnel, Airport, and Railway Engineering.

Water Resources and Environmental Engineering: Introduction, Sources of water- Quality of water- Specifications- Introduction to Hydrology–Rainwater Harvesting-Water Storage and Conveyance Structures (Simple introduction to Dams and Reservoirs).

Textbooks

1. Basic Civil Engineering, M.S.Palanisamy, Tata Mcgraw Hill publications (India) Pvt. Ltd. Fourth Edition.
2. Introduction to Civil Engineering, S.S. Bhavikatti, New Age International Publishers. 2022. First Edition.
3. Basic Civil Engineering, Satheesh Gopi, Pearson Publications, 2009, First Edition.

Reference Books

1. Surveying, Vol- I and Vol-II, S.K. Duggal, Tata McGraw Hill Publishers 2019. Fifth Edition.
2. Hydrology and Water Resources Engineering, Santosh Kumar Garg, Khanna Publishers, Delhi. 2016
3. Irrigation Engineering and Hydraulic Structures - Santosh Kumar Garg, Khanna Publishers, Delhi 2023. 38th Edition.
4. Highway Engineering, S.K.Khanna, C.E.G. Justo and Veeraraghavan, Nemchand and Brothers Publications 2019. 10th Edition.
5. Indian Standard DRINKING WATER — SPECIFICATION IS 10500-2012.

PARTB: BASIC MECHANICAL ENGINEERING

Course Objectives

The students after completing the course are expected to

- Get familiarized with the scope and importance of Mechanical Engineering in different sectors and industries.
- Explain different engineering materials and different manufacturing processes.
- Provide an over view of different thermal and mechanical transmission systems and introduce basics of robotics and its applications.

Course Outcomes

Upon successful completion of the course, the students will be able to

- Select suitable material for the given application.
- Apply the principles of CNC machining and 3D printing to create simple components.
- Examine the working cycles of engines like Otto, Diesel, and IC engines.
- Apply the knowledge of mechanical power transmission systems to solve real-world engineering problems.
- Evaluate the potential applications of robotics in different industries.

UNIT I

Introduction to Mechanical Engineering: Role of Mechanical Engineering in Industries and Society-Technologies in different sectors such as Energy, Manufacturing, Automotive, Aerospace, and Marine sectors.

Engineering Materials - Metals-Ferrous and Non-ferrous, Ceramics, Composites, Smart materials.

UNIT II

Manufacturing Processes: Principles of Casting, Forming, joining processes, Machining, Introduction to CNC machines, 3D printing, and smart manufacturing.

Thermal Engineering: Working principle of Boilers, Otto cycle, Diesel cycle, Refrigeration and air-conditioning cycles, IC engines, 2-Stroke and 4-Stroke engines, S I CI Engines, Components of Electric and Hybrid Vehicles.

UNIT III

Powerplants - Working principle of Steam, Diesel, Hydro, Nuclear power plants.

Mechanical Power Transmission - Belt Drives, Chain, Rope drives, Gear Drives and their applications.

Introduction to Robotics - Joints & links, configurations, and applications of robotics.

(Note: The subject covers only the basic principles of Civil and Mechanical Engineering systems. The evaluation shall be intended to test only the fundamentals of the subject.)

Textbooks

1. Internal Combustion Engines by V.Ganesan, By Tata Mc Graw Hill publications (India) Pvt. Ltd.
2. A text book of Theory of Machines by S. S. Rattan, Tata Mc Graw Hill Publications, (India) Pvt. Ltd.
3. An introduction to Mechanical Engg by Jonathan Wicker and Kemper Lewis, Cengage learning India Pvt. Ltd.

Reference Books

1. G. Shanmugamand M.S.Palanisamy, Basic Civil and the Mechanical Engineering, Tata Mc Graw Hill publications (India)Pvt. Ltd.
2. Thermal Engineering by Mahesh M Rathore Tata Mc Graw Hill publications (India) Pvt. Ltd.
3. 3D printing & Additive Manufacturing Technology - L. Jyothish Kumar, Pulak M Pandey, Springer publications
4. Appuu Kuttan K K, Robotics, I. K. International Publishing House Pvt. Ltd. Volume-I

ENGINEERING MECHANICS

(Common to CE & ME)

I Year – II Semester

Lecture :3	Internal Marks : 30
Credits :3	External Marks : 70

Course Objectives

- To get familiarized with different types of force systems.
- To draw accurate free body diagrams representing forces and moments acting on a body to analyze the equilibrium of system of forces.
- To teach the basic principles of center of gravity, centroid and moment of inertia and determine them for different simple and composite bodies.
- To apply the Work-Energy method to particle motion.
- To understand the kinematics and kinetics of translational and rotational motion of rigid bodies.

Course Outcomes

Upon successful completion of the course, the students will be able to

- Understand the fundamental concepts in mechanics and determine the frictional forces for bodies in contact.
- Analyze different force systems such as concurrent, coplanar and spatial systems and calculate their resultant forces and moments.
- Calculate the centroids, center of gravity and moment of inertia of different geometrical shapes.
- Apply the principles of work-energy and impulse-momentum to solve the problems of rectilinear and curvilinear motion of a particle.
- Solve the problems involving the translational and rotational motion of rigid bodies.

UNIT I

Introduction to Engineering Mechanics – Basic Concepts. Scope and Applications

Systems of Forces: Coplanar Concurrent Forces– Components in Space–Resultant–Moment of Force and its Application – Couples and Resultant of Force Systems.

Friction: Introduction, limiting friction and impending motion, Coulomb'slaws of dryfriction, coefficient of friction, Cone of Static friction.

UNIT II

Equilibrium of Systems of Forces: Free Body Diagrams, Lami's Theorm, Equations of Equilibrium of Coplanar Systems, Graphical method for the equilibrium, Triangle law of forces, converse of the law of polygon of forces condition of equilibrium, Equations of Equilibrium for Spatial System of forces, Numerical examples on spatial system of forces using vector approach, Analysis of plane trusses.

Principle of virtual work with simple examples

UNIT III

Centroid: Centroids of simple figures (from basic principles)–Centroids of Composite Figures. Centre of Gravity: Centre of gravity of simple body (from basic principles), Centre of gravity of composite bodies, Pappus theorems.

Area Moments of Inertia: Definition– Polar Moment of Inertia, Transfer Theorem, Moments of Inertia of Composite Figures, Products of Inertia, Transfer Formula for Product of Inertia.

Mass Moment of Inertia: Moment of Inertia of Masses, Transfer Formula for Mass Moments of Inertia, Mass Moment of Inertia of composite bodies.

UNIT IV

Rectilinear and Curvilinear motion of a particle: Kinematics and Kinetics –D'Alembert's Principle - Work Energy method and applications to particle motion-Impulse Momentum method.

UNIT V

Rigid body Motion: Kinematics and Kinetics of translation, Rotation about fixed axis and plane motion, Work Energy method and Impulse Momentum method.

Textbooks:

1. Engineering Mechanics, S. Timoshenko, D. H. Young, J.V. Rao, S. Pati., , McGraw Hill Education 2017. 5th Edition.
2. Engineering Mechanics, P.C.Dumir- S.Sengupta and Srinivas V veeravalli , University press. 2020. First Edition.
3. A Textbook of Engineering Mechanics, S.S Bhavikatti. New age international publications 2018. 4th Edition.

Reference Books:

1. Engineering Mechanics, Statics and Dynamics, Rogers and M A. Nelson., McGraw Hill Education. 2017. First Edition.
2. Engineering Mechanics, Statics and Dynamics, I.H. Shames., PHI, 2002. 4th Edition.
3. Engineering Mechanics, Volume-I: Statics, Volume-II: Dynamics, J. L. Meriam and L.G. Kraige., John Wiley, 2008. 6th Edition.
4. Introduction to Statics and Dynamics, Basudev Battachatia, Oxford University Press, 2014. Second Edition
5. Engineering Mechanics: Statics and Dynamics, Hibbeler R.C., Pearson Education, Inc., New Delhi, 2022, 14th Edition

COMMUNICATIVE ENGLISH LAB

(Common to All Branches)

I Year – II Semester

Practical :2	Internal Marks : 30
Credits :1	External Marks : 70

Course Objectives: The main objective of introducing this course, Communicative English Laboratory, is to expose the students to a variety of self-instructional, learner friendly modes of language learning. The students will get trained in basic communication skills and also make them ready to face job interviews.

Course Outcomes

Upon successful completion of the course, the students will be able to

- Understand the different aspects of the English language proficiency with emphasis on LSRW skills.
- Apply communication skills through various language learning activities.
- Analyze the English speech sounds, stress, rhythm, intonation and syllable division for better listening and speaking comprehension.
- Evaluate and exhibit professionalism in participating in debates and group discussions.
- Create effective Course Objectives:

List of Topics:

1. Vowels & Consonants
2. Neutralization/Accent Rules
3. Communication Skills & JAM
4. Role Play or Conversational Practice
5. E-mail Writing
6. Resume Writing, Cover letter, SOP
7. Group Discussions-methods & practice
8. Debates - Methods & Practice
9. PPT Presentations/ Poster Presentation
10. Interviews Skills

Suggested Software:

Walden Infotech
Young India
Films
K- Van

Reference Books:

1. Raman Meenakshi, Sangeeta-Sharma. *Technical Communication*. Oxford Press.2018.
2. Taylor Grant: *English Conversation Practice*, Tata McGraw-Hill Education India, 2016
3. Hewing's, Martin. Cambridge *Academic English* (B2). CUP, 2012.
4. J. Sethi & P.V. Dhamija. *A Course in Phonetics and Spoken English*, (2nd Ed), Kindle, 2013

ENGINEERING CHEMISTRY LAB

(Common to CE & ME)

I Year – II Semester

Practical :2	Internal Marks : 30
Credits :1	External Marks : 70

Course Objectives

- To impart skills in analysing the quality of water, lubricating oils and fuels.

Course Outcomes

Upon successful completion of the course, the students will be able to

- analyze the quality of water.
- analyze the percentage of Iron and Calcium in cement.
- synthesize polymers and nanomaterials.
- determine the strength of acid in batteries.
- analyze the quality of fuels and lubricants.

List of Experiments

(Any TEN of the listed experiments are to be conducted)

1. Determination of Hardness of a groundwater sample.
2. Estimation of Dissolved Oxygen by Winkler's method
3. Determination of Strength of an acid in Pb-Acid battery
4. Preparation of a polymer (Bakelite)
5. Determination of percentage of Iron in Cement sample by colorimetry
6. Estimation of Calcium in port land Cement
7. Preparation of nanomaterials by precipitation method.
8. Adsorption of acetic acid by charcoal
9. Determination of percentage Moisture content in a coal sample
10. Determination of Viscosity of lubricating oil by Redwood Viscometer 1
11. Determination of Viscosity of lubricating oil by Redwood Viscometer 2
12. Determination of Calorific value of gases by Junker's gas Calorimeter

Reference:

- "Vogel's Quantitative Chemical Analysis 6th Edition" Pearson Publications by J. Mendham, R.C. Denney, J.D. Barnes and B. Siva sankar

ENGINEERING MECHANICS AND BUILDING PRACTICES LAB

(CE)

I Year – II Semester

Practical :3	Internal Marks : 30
Credits :1.5	External Marks : 70

Course Objectives

The students completing the course are expected to

- Verify the Law of Parallelogram of Forces and Lami's theorem.
- Determine the coefficients of friction of Static and Rolling friction and Centre of gravity of different plane Lamina.
- Understand the layout of a building, concepts of Non-Destructive Testing and different Alternative Materials.

Course Outcomes

Upon successful completion of the course, the students will be able to

- Evaluate the coefficient of friction between two different surfaces and between the inclined plane and the roller.
- Verify Law of Parallelogram of forces and Law of Moment using force polygon and bell crank lever.
- Determine the Centre of gravity different configurations and
- Understand the Quality Testing and Assessment Procedures and principles of Non-Destructive Testing.
- Exposure to safety practices in the construction industry.

Students have to perform any 10 of the following Experiments

To study various types of tools used in construction.

1. Forces in Pin Jointed Trusses
2. Experimental Proof of Lami's Theorem
3. Verification of Law of Parallelogram of Forces.
4. Determination of Center of Gravity of different shaped Plane Lamina.
5. Determination of coefficient of Static and Rolling Friction.
6. Verification of Law of Moment using Rotation Disc Apparatus and Bell Crank Lever
7. Study of Alternative Materials like M-sand, Fly ash, Sea Sand etc.
8. Field-Visit to understand the Quality Testing - report.
9. Safety Practices in Construction industry
10. Demonstration of Non-Destructive Testing - using Rebound Hammer & UPV
11. Study of Plumbing in buildings.

ENGINEERING WORKSHOP

(Common to All Branches)

I Year – II Semester

Practical :3	Internal Marks : 30
Credits :1.5	External Marks : 70

Course Objectives

- To familiarize students with wood working, sheet metal operations, fitting, electrical house wiring skills, and basic repairs of two-wheeler vehicle.

Course Outcomes

Upon successful completion of the course, the students will be able to

- demonstrate the correct use of safety equipment and procedures
- fabricate the lap joint, dovetail joint with the use of woodworking tools.
- utilize sheet metal tools to create tapered tray, conical funnel, elbow pipe and perform brazing.
- perform fitting exercises such as v-fit, dovetail fit, semicircular fit, and bicycle tire puncture and change.
- create electrical connections, including parallel and series circuits, and tube lights
- create green sand moulds for provided patterns.
- perform arc and gas welding to create lap and butt joints.
- create pipe joints with couplings for the same diameter and reducers for different diameters. perform basic repairs and maintenance on a two-wheeler vehicle

Course Content

1. **Demonstration**: Safety practices and precautions to be observed in workshop.
2. **Wood Working:** Familiarity with different types of woods and too lsused in wood working and make following joints.
   a) Half Lap joint b) Mortise and Tenon joint c) Corner Dovetail joint or Bridle joint
3. **Sheet Metal Working**: Familiarity with different types of tools used in sheet metal working, Developments of following sheet metal job from GI sheets.
   a) Tapered tray b) Conical funnel c) Elbow pipe d)Brazing
4. **Fitting:** Familiarity with different types of tools used in fitting and do the following fitting exercises.
   a) V- fit b) Dovetail fit c)Semi-circular fit d) Bicycle tire puncture and change of two-wheeler tyre
5. **Electrical Wiring**: Familiarity with different types of basic electrical circuits and make the following connections.
   a) Parallel and series b)Two-way switch c) Go down lighting
   d) Tube light e) Three phase motor f) Soldering of wires
6. **Foundry Trade:** Demonstration and practice on Moulding tools and processes, Preparation of Green sand Moulds for given Patterns.
7. **Welding Shop**: Demonstration and practice on Arc Welding and Gas welding. Preparation of Lap joint and Butt joint.
8. **Plumbing:** Demonstration and practice of Plumbing tools, Preparation of Pipe joints with coupling for same diameter and with reducer for different diameters.
9. **Basic repairs of Two-wheeler vehicle** – Demonstration of working of two-wheeler vehicle and its repairs.

Text Books:

1. Basic Workshop Technology: Manufacturing Process, Felix W.; Independently Published, 2019. Work shop Processes, Practices and Materials; Bruce J. Black, Routl

edge publishers, 5th Edn. 2015.
2. A Course in Workshop Technology Vol I. & II, B.S. Raghu wanshi, Dhanpath Rai & Co., 2015 & 2017.

Reference Books:

1. Elements of Workshop Technology, Vol. I by S.K. Hajra Choudhary & Others, Media Promoters and Publishers, Mumbai, 2007, 14th Edition.
2. Workshop practice by H.S. Bawa, Tata-McGraw Hill, 2004.
3. Wiring Estimating, Costing and Contracting; Soni P.M. &Upadhyay P.A; Atul Prakasham, 2022.

HEALTH AND WELLNESS, YOGA AND SPORTS

(Common to All Branches)

I Year – II Semester

Practice :1 Internal Marks : 100

Credits :0.5

Course Objectives

- The main objective of introducing this course is to make the students maintain their mental and physical wellness by balancing emotions in their life. It mainly enhances the essential traits required for the development of the personality.

Course Outcomes

Upon successful completion of the course, the students will be able to

- Understand the importance of yoga and sports for Physical fitness and sound health
- Demonstrate an understanding of health-related fitness components.
- Compare and contrast various activities that help enhance their health
- Assess current personal fitness levels.
- Develop Positive Personality

UNIT – I

Concept of health and fitness, Nutrition and Balanced diet, basic concept of immunity Relationship between diet and fitness, Globalization and its impact on health, Body Mass Index (BMI) of all age groups.

Activities:

i) Organizing health awareness programmes in community
ii) Preparation of health profile
iii) Preparation of chart for balance diet for all age groups

UNIT – II

Concept of yoga, need for and importance of yoga, origin and history of yoga in Indian context, classification of yoga, Physiological effects of Asanas- Pranayama and meditation, stress management and yoga, Mental health and yoga practice.

Activities:

i) Yoga practices – Asana, Kriya, Mudra, Bandha, Dhyana, Surya Namaskar

UNIT – III

Concept of Sports and fitness, importance, fitness components, history of sports, Ancient and Modern Olympics, Asian games and Commonwealth games.

Activities:

i) Participation in one major game and one individual sport viz., Athletics, Volleyball, Basketball, Handball, Football, Badminton, Kabaddi, Kho-kho, Table tennis, Cricket etc. Practicing general and specific warm up, aerobics
ii) Practicing cardiorespiratory fitness, treadmill, run test, 9 min walk, skipping and running.

Reference Books

1. Gordon Edlin, Eric Golanty. Health and Wellness, 14th Edn. Jones & Bartlett Learning, 2022
2. T.K.V.Desikachar. The Heart of Yoga: Developing a Personal Practice
3. Archie J.Bahm. Yoga Sutras of Patanjali, Jain Publishing Company, 1993

4. Wiseman, John Lofty, SAS Survival Handbook: The Ultimate Guide to Surviving Anywhere Third Edition, William Morrow Paperbacks, 2014
5. The Sports Rules Book/ Human Kinetics with Thomas Hanlon. -- 3rd ed. Human Kinetics, Inc.2014

General Guidelines:

1. Institutes must assign slots in the Timetable for the activities of Health/Sports/Yoga.
2. Institutes must provide field/facility and offer the minimum of five choices of as many as Games/Sports.
3. Institutes are required to provide sports instructor / yoga teacher to mentor the students.

Evaluation Guidelines

- Evaluated for a total of 100 marks.
- A student can select 6 activities of his/her choice with a minimum of 01 activity per unit. Each activity shall be evaluated by the concerned teacher for 15 marks, totalling to 90 marks.
- A student shall be evaluated by the concerned teacher for 10 marks by conducting viva voce on the subject.

MANAGERIAL ECONOMICS AND FINANCIAL ANALYSIS

(Common to CE, ECE & AI&DS)

II Year – I Semester

Lecture : 2	Internal Marks : 30
Credits : 2	External Marks : 70

Course Objectives

- To expose the importance of managerial economics and its role in achieving business objectives.
- To present fundamental skills on accounting and to explain the process of preparing financial statements.

Course Outcomes

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

- classify the concepts of Managerial Economics, Financial Accounting and Management.
- interpret the Concept of Product cost and revenues for effective Business decision.
- establish suitable business organization and analyse markets to understand their impact on pricing & output decisions.
- analyze how to invest their capital and maximize returns using capital Budgeting techniques.
- develop the accounting statements and evaluate the financial performance of business entity.

Course Content

UNIT – I : Managerial Economics

Introduction – Nature, meaning, significance, functions, and advantages. Demand-Concept, Function, Law of Demand – Demand Elasticity – Types – Measurement. Demand Forecasting-Factors governing Forecasting, Methods.

UNIT – II : Product and Cost Analysis

Introduction – Segmentation – Product Life cycle – Channels of Distribution – Cost & Break-Even Analysis – Cost concepts and Cost behavior – Break-Even Analysis (BEA) – Determination of Break-Even Point (Simple Problems).

UNIT –III: Business Organizations and Markets

Introduction – Forms of Business Organizations – Sole Proprietary – Partnership – Joint Stock Companies – Public Sector Enterprises. Types of Markets – Perfect and Imperfect Competition – Features of Perfect Competition, Monopoly, Monopolistic Competition, Oligopoly-Price-Output Determination – Pricing Methods and Strategies.

UNIT – IV : Capital Budgeting

Introduction – Nature, meaning, significance. Types of Working Capital, Components, Sources of Short-term and Long-term Capital, Estimating Working capital requirements. Capital Budgeting – Features, Proposals, Methods and Evaluation. Projects—Pay Back Method, Accounting Rate of Return (ARR), Net Present Value (NPV), Internal Rate Return(IRR) Method (sample problems).

UNIT – V : Financial Accounting and Analysis

Introduction – Concepts and Conventions – Double-Entry Bookkeeping, Journal, Ledger, Trial Balance – Final Accounts (Trading Account, Profit and Loss Account and Balance Sheet with simple adjustments). Introduction to Financial Analysis – Analysis and Interpretation of Liquidity Ratios, Activity Ratios, and Capital structure Ratios and Profitability.

Textbooks:

1. Varshney & Maheswari "Managerial Economics" 22nd Edition, Sultan Chand, 2014.
2. Aryasri "Business Economics and Financial Analysis" 4th Edition, MGH, 2019.
3. Philip kotler "Marketing Management" 15th Edition, pearson, 2016.

Reference Books:

1. Ahuja Hl "Managerial economics" 3rd Edition, Schand, 2013.
2. S.A. Siddiqui and A.S. Siddiqui "Managerial Economics and Financial Analysis" New Age International, 2013.
3. Joseph G. Nellis and David Parker "Principles of Business Economics" Pearson, 2nd Edition, New Delhi.

e-Learning Resources:

1. https://www.slideshare.net/123ps/managerial-economics-ppt
2. https://www.slideshare.net/rossanz/production-and-cost-45827016
3. https://www.slideshare.net/darky1a/business-organizations-19917607
4. https://www.slideshare.net/ba1arajbl/market-and-classification-of-market
5. https://www.slideshare.net/ruchi101/capital-budgeting-ppt-59565396
6. https://www.slideshare.net/ashu1983/financial-accounting

SURVEYING

II Year – I Semester

Lecture : 3	Internal Marks : 30
Credits : 3	External Marks : 70

Course Objectives:

- To know the principle and methods of surveying and measuring of horizontal and vertical- distances and angles.
- To familiarize with leveling and impart knowledge on areas and volumes for different boundary.
- To create awareness on heights and distances using trigonometric principles.
- To set out curves and use modern surveying equipment's for accurate results.
- To know the basics of Tacheometric and Photogrammetry Surveying.

Course Outcomes:

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

- apply the principle and methods of surveying and measuring of horizontal and vertical-distances and angles.
- determine the levels and obtain areas and volumes.
- calculate heights and distances using trigonometric principles.
- setting out curves and using modern surveying equipment's.
- apply the basics of Tacheometric concepts for heights & distances and Photogrammetry Surveying for map study in field.

Course Content

UNIT – I:

Introduction and Basic Concepts: Introduction, Objectives, classification and principles of surveying, Surveying accessories. Introduction to Plane table surveying.

Linear Distances: Approximate methods, Direct Methods – Chains – Tapes, ranging, Tape corrections – Length, Temperature, Pull and Sag.

Prismatic Compass: Bearings, included angles, Local Attraction, Magnetic Declination, and dip – systems and W.C.B and Q.B systems of locating bearings.

UNIT – II:

Leveling: Types of levels, methods of leveling, and Determination of levels, Effect of Curvature of Earth and Refraction.

Contouring: Characteristics and uses of Contours, methods of contour surveying.

Areas: Determination of areas consisting of irregular boundary and regular boundary.

Volumes: Determination of volume of earth work in cutting and embankments for level section, Volume by Contour Plan for capacity of reservoirs.

UNIT – III:

Theodolite Surveying: Types of Theodolites, temporary adjustments, measurement of horizontal angle by repetition method and reiteration method, measurement of vertical Angle, Trigonometrical leveling when base is accessible and inaccessible.

Traversing: Methods of traversing– Fast needle Method, Introduction to Omitted measurements.

UNIT – IV:

Curves: Types of curves and their necessity, elements of simple, compound, reverse curves, Methods of Setting out curves.

Modern Surveying Methods: Principle and types of E.D.M. Instruments, Total station-advantages and Applications. Introduction to Global Positioning System. Introduction to Drone survey and LiDAR Survey (Light Detection and Ranging).

UNIT – V:

Introduction to Tacheometric Surveying.

Stadia methods-fixed hair method & movable hair method, Principle of stadia method, Determination of vertical and horizontal distances when staff is vertical (Inclined sight).

Photogrammetry Surveying:
Introduction, terrestrial photogrammetry, aerial photogrammetry, relief and tilt displacements, flight planning, ground control for photographic mapping, aerial triangulation, radial triangulation – methods, Stereoscopy, Stereoscopic plotting techniques and Mosaics.

Text Books:

1. B. C. Punmia, Ashok Kumar Jain and Arun Kumar Jain "Surveying (Vol – 1,2)" 18th Edition, Laxmi Publications (P) ltd., New Delhi, 2024.
2. Duggal S K "Surveying (Vol – 1 & 2)" 5th Edition, Tata McGraw Hill Publishing Co. Ltd. New Delhi, 2019.
3. Chandra A M "Plane Surveying and Higher Surveying" 3rd Edition, New age International Pvt. Ltd., Publishers, New Delhi, 2015.

Reference Books:

1. Arora K R "Surveying (Vol 1, 2 & 3)" 12th Edition, Standard Book House, Delhi, 2015.
2. C Venkatramaiah "Textbook of Surveying" 1st Edition, Universities Press, 2011.
3. Sateesh Gopi, R Santhi Kumar and N Madhu "Advanced Surveying" 1st Edition, Pearson, 2007.

e-Learning Resources:

1. https://koha.srmap.edu.in/cgi-bin/koha/opacdetail.pl?biblionumber=11522&shelfbrowse_itemnumber=23066

STRENGTH OF MATERIALS

II Year – I Semester

Lecture : 3	Internal Marks : 30
Credits : 3	External Marks : 70

Course Objectives:

- To impart Fundamental knowledge on stress strain behavior of steel, relationship between elastic constants and stresses generated in composite bars.
- To impart the concepts of shear force and bending moment for various types of beams and various loading conditions.
- To know the concepts of flexural stresses in the girder and applications of bending equation for different cross sections.
- To familiarize the concepts of measuring deflections in beams under various loading and support conditions.
- To classify the columns based on their support conditions and to calculate the hoop and longitudinal stresses in cylinders.

Course Outcomes:

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

- understand the behavior of basic materials under the influence of different external loading conditions and different support conditions.
- draw the diagrams indicating the variation of the key performance features like axial forces, bending moment and shear forces in structural members.
- acquire the knowledge on bending and shear stress distribution across different cross sections of a beam.
- determine the deflections of determinate beams w.r.t various loading conditions.
- assess the load bearing capacity of columns having different boundary conditions and also to determine the stresses across sections of thin and thick cylinders so as to arrive the optimum sections to withstand the internal pressure using Lame's equation.

Course Content

UNIT – I :

Simple Stresses and Strains: Elasticity and plasticity – Types of stresses and strains – Hooke's law – Factor of safety, Poisson's ratio – Relationship between Elastic constants – Bars of varying section – stresses in composite bars.

UNIT – II:

Shear Force and Bending Moment: Definition of beam – Types of beams – Concept of shear force and bending moment – Point of contra flexure – Relation between S.F., B.M and rate of loading at a section of a beam; S.F and B.M diagrams for cantilever, simply supported and overhanging beams subjected to point loads, uniformly distributed loads, uniformly varying loads, partial uniformly distributed loads, couple and combination of these loads.

UNIT–III :

Flexural and Shear Stresses:

Flexural Stresses: Theory of simple bending – Assumptions – Derivation of bending equation, Neutral axis – Determination of bending stresses – section modulus of rectangular and circular sections (Solid and Hollow), I, T, Angle and Channel sections – Design of simple beams

Shear Stresses: Derivation of formula – Shear stress distribution across various beam sections like rectangular, circular, I, T Angle sections.

Torsion – circular shafts only.

UNIT–IV :

Deflection of Beams: Double integration and Macaulay's methods – Determination of slope and deflection for cantilever, simply supported and overhanging beams subjected to point loads, uniformly distributed loads, uniformly varying loads, partial uniformly distributed loads, couple and combination of these loads. Mohr's theorems – Moment area method – application to simple cases of cantilever.

UNIT–V :

Introduction – Classification of columns – Axially loaded compression members – Euler's crippling load theory – Derivation of Euler's critical load formulae for various end conditions – Equivalent length – Slenderness ratio – Euler's critical stress – Limitations of Euler's theory – Rankine – Gordon formula – Eccentric loading and Secant formula – Prof. Perry's formula.

Thin and Thick cylindrical shells – Derivation of formula for longitudinal and circumferential stresses – hoop, longitudinal and volumetric strains – changes in diameter, and volume of thin cylinders. Lames theory for thick cylinders, Derivation of Lames formulae, distribution of hoop and radial stresses across the thickness, compound cylinders distribution of stresses.

Text Books:

1. R. K. Bansal "Strength of Materials" 16th Edition, Lakshmi Publications, 2022.
2. B. S. Basavarajaiah and P. Mahadevappa "Strength of Materials" 3rd Edition, Universities Press 2010.
3. J.K. Gupta and S.K. Gupta "Strength of Materials" 2nd Edition, Cengage publications 2024.

Reference Books:

1. L.S Srinath "Advanced Mechanics of Solids" 3rd Edition, McGraw Hill Education, , 2017.
2. T.D.Gunneswara Rao and Mudimby Andal "Strength of Materials - Fundamentals and Applications" 1st Edition, Cambridge University Press, 2018.
3. Beer and Johnston "Mechanics of Materials" 8th Edition, McGraw Hill India Pvt. Ltd., (SI Units), 2020.

FLUID MECHANICS

II Year – I Semester

Lecture : 3	Internal Marks : 30
Credits : 3	External Marks : 70

Course Objectives:

- To explain basics of statics, kinematics and dynamics of fluids and various measuring techniques of hydrostatic forces on objects.
- To impart ability to solve engineering problems in fluid mechanics.
- To enable the students measure quantities of fluid flowing in pipes, tanks and channels.
- To teach integral forms of fundamental laws of fluid mechanics to predict relevant pressures, velocities and forces.
- To strengthen the students with fundamentals useful in application-intensive courses dealing with hydraulics, hydraulic machinery and hydrology in future courses.

Course Outcomes:

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

- analyse fluid properties and principles of fluid statics, kinematics and dynamics.
- apply the laws of fluid statics and concepts of buoyancy.
- identify and analyse various types of fluid flows.
- apply the principle of conservation of energy for flow measurement.
- analyze the losses in pipes and discharge through pipe network.

Course Content

UNIT – I:

Basic Concepts and Definitions: Distinction between a fluid and a solid; Density, Specific weight, Specific gravity, Kinematic and dynamic viscosity; Variation of viscosity with temperature, Newton law of viscosity; Vapor pressure, Boiling point, Surface tension, Capillarity, Bulk modulus of elasticity, Compressibility

UNIT – II :

Fluid Statics: Fluid Pressure: Pressure at a point, Pascal‘s law, pressure variation with temperature, density and altitude. Piezometer, U-Tube Manometer, Single Column Manometer, U Tube Differential Manometer. Pressure gauges, Hydrostatic pressure and force: horizontal, vertical and inclined surfaces. Buoyancy and stability of floating bodies

UNIT – III:

Fluid Kinematics: Classification of fluid flow : steady and unsteady flow; uniform and non-uniform flow; laminar and turbulent flow; rotational and irrotational flow; compressible and incompressible flow; ideal and real fluid flow; one, two and three dimensional flows; Stream line, path line, streak line and stream tube; stream function, velocity potential function. One-, two- and three-Dimensional continuity equations in Cartesian coordinates.

UNIT – IV:

Fluid Dynamics: Surface and body forces; Equations of motion - Euler‘s equation; Bernoulli‘s equation – Derivation; Energy Principle; Practical applications of Bernoulli‘s equation : Venturimeter, orifice meter and Pitot tube; Momentum principle; Forces exerted by fluid flow

on pipe bend; Vortex Flow – Free and Forced; Definitions of Reynolds Number, Froude Number, Mach Number, Weber Number and Euler Number;

UNIT – V:

Analysis of Pipe Flow: Energy losses in pipelines; Darcy – Weisbach equation; Minor losses in pipelines; Hydraulic Grade Line and Total Energy Line; Concept of equivalent length – Pipes in Parallel and Series.

Text Books:

1. P. M. Modi and S. M. Seth "Hydraulics and Fluid Mechanics" 22nd Edition, Standard Book House, 2019.
2. K. Subrahmanya "Theory and Applications of Fluid Mechanics" 2nd Edition, Tata McGraw Hill, 2018

Reference Books:

1. R. K. Bansal "A text of Fluid mechanics and hydraulic machines" 11th Edition, Laxmi Publications (P) Ltd., New Delhi, 2024.
2. N. Narayana Pillai "Principles of Fluid Mechanics and Fluid Machines" 3rd Edition, Universities Press Pvt Ltd, Hyderabad, 2009.
3. Frank M. White, Henry Xue "Fluid Mechanics" 9th Edition, Tata McGraw Hill, 2022.

e-Learning Resources:

1. https://archive.nptel.ac.in/courses/112/105/112105269/https://nptel.ac.in/courses/112104118https://nptel.ac.in/courses/105103192

SURVEYING LAB

II Year – I Semester

Practice : 3	Internal Marks : 30
Credits : 1.5	External Marks : 70

Course Objectives:

- To know about various linear and angular measuring instruments.
- To take measurements in the linear and angular view.
- To determine the area and volume by interpreting the data obtained from surveying activities.
- To know modern equipment such as total station.
- To draft field notes from survey data.

Course Outcomes:

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

- handle various linear and angular measuring instruments.
- measure the linear and angular measurements.
- calculate the area by interpreting the data obtained from surveying activities.
- handle modern equipment such as total station.
- prepare field notes from survey data.

List of Experiments

Perform any 10 of the following experiments

1. Chain survey of road profile with offsets in case of road widening.
2. Determination of distance between two inaccessible points by using compass.
3. Plane table survey; finding the area of a given boundary by the method of Radiation
4. Fly levelling: Height of the instrument method (differential leveling)
5. Fly levelling: rise and fall method.
6. Theodolite survey: determining the horizontal and vertical angles by the method of repetition method
7. Theodolite survey: finding the distance between two in accessible points.
8. Theodolite survey: finding the height of far object.
9. Determination of area perimeter using total station.
10. Determination of distance between two inaccessible point by using total station.
11. Setting out a curve
12. Determining the levels of contours

STRENGTH OF MATERIALS LAB

II Year – I Semester

Practice : 3	Internal Marks : 30
Credits : 1.5	External Marks : 70

Course Objectives:

- To determine the tensile strength and yield parameters of mild steel.
- To find out flexural strengths of Steel/Wood specimens and measure deflections.
- To determine the torsion parameters of mild steel bar.
- To determine the hardness numbers, impact and shear strengths of metals.
- To determine the load-deflection parameters for springs.

Course Outcomes:

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

- conduct tensile strength test and draw stress-strain diagrams for ductile metals.
- perform bending test and determine load-deflection curve of steel/wood.
- conduct torsion test and determine torsion parameters.
- perform hardness, impact and shear strength tests and calculate hardness numbers, impact and shear strengths.
- conduct tests on closely coiled and open coiled helical springs and calculate the deflections.

List of Experiments

Perform any 10 of the following experiments

1. Tension test.
2. Bending test on (Steel/Wood) Cantilever beam.
3. Bending test on simply supported beam.
4. Torsion test.
5. Hardness test.
6. Compression test on Open coiled springs
7. Tension test on Closely coiled springs
8. Compression test on wood/ concrete
9. Izod / Charpy Impact test on metals
10. Shear test on metals
11. Use of electrical resistance strain gauges.
12. Continuous beam – deflection test.

DESIGN THINKING & INNOVATION

(Common to CE, ME, IT, CSE (AI&ML), IOT)

II Year – I Semester

Lecture : 1	Practical : 2	Internal Marks	: 30
Credits : 3		External Marks	: 70

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Course Objectives

- To develop a comprehensive understanding of design thinking, its history, principles, and application in various contexts, including product development and business innovation.
- To apply the design thinking process and tools to foster creativity, drive innovation, and address real-world challenges in both social and business settings.

Course Outcomes

Upon successful completion of the course, the students will be able to

- analyse the elements and principles of design.
- implement the design thinking process (empathize, analyze, ideate, and prototype) to drive inventions and social innovations.
- analyse the difference between innovation and creativity, to foster innovation within organization.
- create a comprehensive product design by forming and solving problems, setting product strategies, values, planning, and specifications, and evaluating case studies for practical insights.
- apply design thinking principles to redefine business strategies and address business challenges.

Course Content

UNIT I: Introduction to Design Thinking

Introduction to elements and principles of design, basics of design-dot, line, shape, form as fundamental design components - Principles of design - Introduction to design thinking, history of design thinking, new materials in industry.

UNIT II: Design Thinking Process

Design thinking process (empathize, analyze, idea & prototype), implementing the process in driving inventions, design thinking in social innovations. Tools of design thinking - person, costumer, journey map, brain storming, product development

Activity: Every student presents their idea in three minutes, every student can present design process in the form of flow diagram or flow chart etc. Every student should explain about product development.

UNIT III: Innovation

Art of innovation, difference between innovation and creativity, role of creativity and innovation in organizations. Creativity to innovation. Teams for innovation, measuring the impact and value of creativity.

Activity: Debate on innovation and creativity, flow and planning from idea to innovation, debate on value-based innovation.

UNIT IV: Product Design

Problem formation, introduction to product design, product strategies, product value, product planning, product specifications. Innovation towards product design case studies.

Activity: Importance of modeling, how to set specifications, explaining their own product design.

UNIT V: Design Thinking in Business Processes

Design thinking applied in business & strategic Innovation, design thinking principles that redefine business – Business challenges: growth, predictability, change, maintaining relevance, extreme competition, standardization. Design thinking to meet corporate needs. Design thinking for startups. Defining and testing Business Models and Business Cases. Developing & testing prototypes.

Activity: How to market our own product, about maintenance, Reliability and plan for startup.

Text Books

1. Tim Brown, "Change by Design", 1st Edition, Harper Bollins, 2009.
2. Idris Mootee, "Design Thinking for Strategic Innovation", 1st Edition, Adams Media, 2014.

Reference Books

1. David Lee, "Design Thinking in the Classroom", Ulysses press, 2018.
2. Shrrutin N Shetty, "Design the Future", 1st Edition, Norton Press, 2018.
3. William lidwell, Kritina holden, Jill butter, "Universal principles of design", 2nd Edition, Rockport Publishers, 2010.
4. Henry W. Chesbrough, "The Era of Open Innovation", MIT Sloan Management Review, 2003.
5. Anuja Agarwal, "Design Thinking: A Framework for Applying Design Thinking in Problem Solving", 1st Edition, Cengage learning India Pvt. Ltd., 2023

e-Learning Resources

1. https://nptel.ac.in/courses/110/106/110106124/
2. https://nptel.ac.in/courses/109/104/109104109/
3. https://swayam.gov.in/nd1_noc19_mg60/preview
4. https://onlinecourses.nptel.ac.in/noc2

BUILDING PLANNING AND DRAWING

II Year – I Semester

Tutorial : 1	Practice : 2	Internal Marks : 30
Credits : 2		External Marks : 70

Course Objectives:

- To understand different building bye-laws and regulations required for developing building plans.
- To demonstrate the planning aspects of residential buildings and public buildings.
- To familiarize with various conventional signs and bonds.
- To illustrate different building units and their representation in the master plan.
- To impart the laws, code, skills and methods of planning of various buildings.

Course Outcomes:

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

- plan various buildings as per the building by-laws.
- distinguish the relation between the plan, elevation and cross section and identify the form and functions of the buildings.
- draw signs and bonds.
- draw different building units.
- apply the skills of drawing building elements and plan the buildings as per requirements.

Course Content

1. Detailing & Drawing of Sign Conventions.
2. Detailing & Drawing of English Bond.
3. Detailing & Drawing of Flemish Bond.
4. Detailing & Drawing of Doors.
5. Detailing & Drawing of Windows.
6. Detailing & Drawing of Ventilators &Roofs.
7. Drawing of Line Diagram of Residential Buildings by using Building Bye- Laws.
8. Drawing of Plan, Elevation & Section from line diagram for a single Storey Building.
9. Drawing of Plan, Elevation & Section for Hospital Building.
10. Drawing of Plan, Elevation & Section for Industrial Building.

Text Books:

1. Gurcharan Singh and Jagdish Singh “Planning, designing and Scheduling”.
2. M. Chakraborti “Building planning and drawing”.
3. M G Shah, C M Kale and S Y Patki “Building drawing” Tata McGraw Hill, New Delhi.

Reference Books:

1. National Building Code(NBC) 2016 (Volume- I & II).
2. M G Shah and C M Kale “Principles of Building Drawing” Trinity Publications, New Delhi.
3. B. P. Verma “Civil Engineering drawing and House planning” Khanna publishers, New Delhi.

ENVIRONMENTAL SCIENCE

(Common to CE, EEE, ME, ECE, AI&DS & IOT)

II YEAR – I SEMESTER

Lecture : 2	Internal Marks : 30
Credits : -	External Marks : 70

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Course Objectives

- To impart basic knowledge about the environment and natural resources.
- To develop an attitude of concern for biodiversity conservation and ecosystems.
- To acquire knowledge and skills on environmental pollution control.

Course Outcomes

Upon successful completion of the course, the students will be able to

- create awareness among the people in protection of environment and natural resources.
- analyze structure and functional attributes of an ecosystem and biodiversity conservation.
- identify the sources of environmental pollution, assess their effects and suggest suitable control measures.
- adopt sustainable management practices for various environmental issues.
- recognize the relationship between population growth and health.

Course Content

UNIT – I:

Multidisciplinary Nature of Environmental Studies: Definition, Scope and Importance - Need for Public Awareness.

Natural Resources: Renewable and non-renewable resources - Natural resources and associated problems - Forest resources: Use and over - exploitation, deforestation, case studies - Timber extraction - Mining, dams and other effects on forest and tribal people - Water resources: Use and over utilization of surface and ground water - Floods, drought, conflicts over water, dams - benefits and problems - Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies - Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources.

UNIT – II:

Ecosystems: Concept of an ecosystem - Structure and function of an ecosystem - Producers, consumers and decomposers - Energy flow in the ecosystem - Ecological succession - Food chains, food webs and ecological pyramids - Introduction, types, characteristic features, structure and function of the following ecosystem:

a. Forest ecosystem.
b. Grassland ecosystem
c. Desert ecosystem
d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Biodiversity And Its Conservation: Introduction and Definition: genetic, species and ecosystem diversity - Bio-geographical classification of India - Value of biodiversity: consumptive use, Productive use social, ethical, aesthetic and option values - Biodiversity at global, national and local levels - India as a mega-diversity nation - Hot-sports of biodiversity - Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts - Endangered and endemic species of India - Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

UNIT – III:

Environmental Pollution: Definition, causes, effects and control measures of:

a. Air pollution
b. Water pollution
c. Soil pollution
d. Marine pollution
e. Noise pollution
f. Thermal pollution
g. Nuclear hazards

Solid Waste Management: Causes, effects and control measures of urban and industrial wastes - Role of an individual in prevention of pollution - Pollution case studies - Disaster management: floods, earthquake, cyclone and landslides.

UNIT – IV:

Social Issues and the Environment: From Unsustainable to Sustainable development - Urban problems related to energy - Water conservation, rain water harvesting, watershed management - Resettlement and rehabilitation of people; its problems and concerns. Case studies - Environmental ethics: Issues and possible solutions - Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies - Wasteland reclamation - Consumerism and waste products - Environment Protection Act - Air (Prevention and Control of Pollution) Act - Water (Prevention and Control of Pollution) Act - Wildlife Protection Act - Forest Conservation Act - Issues involved in enforcement of environmental legislation - Public awareness.

UNIT – V:

Human Population and The Environment: Population growth, variation among nations. Population explosion - Family Welfare Programmes - Environment and human health - Human Rights - Value Education - HIV/AIDS - Women and Child Welfare - Role of Information Technology in Environment and human health - Case studies.

Field Work: Visit to a local area to document environmental assets river/forest grassland/hill/mountain - Visit to a local polluted site-Urban/Rural/Industrial/Agricultural Study of common plants, insects, and birds - river, hill slopes, etc.

Text Books

1. Erach Bharucha, "Text book of Environmental Studies for Undergraduate Courses", Universities Press (India) Private Limited, 2019.
2. Palaniswamy, "Environmental Studies", 2nd Edition, Pearson Education, 2014.
3. S.Azeem Unnisa, "Environmental Studies", Academic Publishing Company, 2021.
4. K.Raghavan Nambiar, "Text book of Environmental Studies for Undergraduate Courses (as per UGC model syllabus)", Scitech Publications (India) Pvt. Ltd, 2010.

Reference Books

1. Deeksha Dave and E. Sai Baba Reddy, "Textbook of Environmental Science", 2nd Edition, Cengage Publications, 2012.
2. M. Anji Reddy, "Textbook of Environmental Sciences and Technology", BS Publication, 2014.
3. J. P. Sharma, "Comprehensive Environmental Studies", Laxmi Publications, 2006.
4. J. Glynn Henry and Gary W. Heinke, "Environmental Sciences and Engineering", Prentice Hall of India Private Limited, 1988.
5. G. R. Chatwal, "A Text Book of Environmental Studies", Himalaya Publishing House, 2018.
6. Gilbert M. Masters and Wendell P. Ela, "Introduction to Environmental Engineering and Science", 1st Edition, Prentice Hall of India Private Limited, 1991.

e-Learning Resources:

1. https://onlinecourses.nptel.ac.in/noc23_hs155/preview
2. https://www.edx.org/learn/environmental-science/rice-university-ap-r-environmental-science-part-3-pollution-and-resources?index=product&objectID=course-3a6da9f2-d84c-4773-8388-1b2f8f6a75f2&webview=false&campaign=AP%C2%AE+Environmental+Science++Part+3%3A+Pollution+and+Resources&source=edX&product_category=course&placement_url=https%3A%2F%2Fwww.edx.org%2Flearn%2Fenvironmental-science.
3. http://ecoursesonline.iasri.res.in/Courses/Environmental%20Science-I/Data%20Files/pdf/lec07.pdf
4. https://www.youtube.com/watch?v=5QxxaVfgQ3k

UNIVERSAL HUMAN VALUES – UNDERSTANDING HARMONY AND ETHICAL HUMAN CONDUCT

(Common to CE, ME, IT, CSE(AI&ML), AI&DS & IOT)

II Year – II Semester

Lecture : 2	Tutorial : 1	Internal Marks	: 30
Credits : 3		External Marks	: 70

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Course Objectives

- To help understand the need, basic guidelines, content and process of value education.
- To facilitate the students to understand harmony at all the levels of human living, and live accordingly.
- To understand the harmony in nature and existence.
- To facilitate the students in applying the understanding of harmony in existence in their profession and lead an ethical life.

Course Outcomes:

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

- analyze the essentials of human values and skills, self-exploration, happiness and prosperity.
- evaluate coexistence of the "I" with the body.
- identify and evaluate the role of harmony in family, society and universal order.
- examine the holistic perception of harmony at all levels of existence.
- develop appropriate technologies and management patterns to create harmony in professional and personal lives.

Course Content

The course has 28 lectures and 14 tutorials in 5 modules. The lectures and tutorials are of 1hour duration. Tutorial sessions are to be used to explore and practice what has been proposed during the lecture sessions.

The Teacher's Manual provides the outline for lectures as well as practice sessions. The teacher is expected to present the issues to be discussed as propositions and encourage the students to have a dialogue.

UNIT – I: Introduction to Value Education (6 lectures and 3 tutorials for practice session)

Lecture 1 : Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education)

Lecture 2 : Understanding Value Education

Tutorial 1 : Practice Session PS1 Sharing about Oneself

Lecture 3 : self-exploration as the Process for Value Education

Lecture 4 : Continuous Happiness and Prosperity – the Basic Human Aspirations

Tutorial 2 : Practice Session PS2 Exploring Human Consciousness

Lecture 5 : Happiness and Prosperity – Current Scenario

Lecture 6 : Method to Fulfill the Basic Human Aspirations

Tutorial 3 : Practice Session PS3 Exploring Natural Acceptance

UNIT – II: Harmony in the Human Being (6 lectures and 3 tutorials for practice session)

Lecture 7 : Understanding Human being as the Co-existence of the self and the body.

Lecture 8 : Distinguishing between the Needs of the self and the body

Tutorial 4 : Practice Session PS4 Exploring the difference of Needs of self and body.

Lecture 9 : The body as an Instrument of the self

Lecture 10 : Understanding Harmony in the self

Tutorial 5 : Practice Session PS5 Exploring Sources of Imagination in the self
Lecture 11 : Harmony of the self with the body
Lecture 12 : Programme to ensure self-regulation and Health
Tutorial 6 : Practice Session PS6 Exploring Harmony of self with the body

UNIT – III: Harmony in the Family and Society (6 lectures and 3 tutorials for practice session)

Lecture 13 : Harmony in the Family – the Basic Unit of Human Interaction
Lecture 14 : 'Trust' – the Foundational Value in Relationship
Tutorial 7 : Practice Session PS7 Exploring the Feeling of Trust
Lecture 15 : 'Respect' – as the Right Evaluation
Tutorial 8 : Practice Session PS8 Exploring the Feeling of Respect
Lecture 16 : Other Feelings, Justice in Human-to-Human Relationship
Lecture 17 : Understanding Harmony in the Society
Lecture 18 : Vision for the Universal Human Order
Tutorial 9 : Practice Session PS9 Exploring Systems to fulfill Human Goal

UNIT – IV: Harmony in the Nature/Existence (4 lectures and 2 tutorials for practice session)

Lecture 19 : Understanding Harmony in the Nature
Lecture 20 : Interconnectedness, self-regulation and Mutual Fulfillment among the Four Orders of Nature
Tutorial 10: Practice Session PS10 Exploring the Four Orders of Nature
Lecture 21 : Realizing Existence as Co-existence at All Levels
Lecture 22 : The Holistic Perception of Harmony in Existence
Tutorial 11: Practice Session PS11 Exploring Co-existence in Existence.

UNIT – V: Implications of the Holistic Understanding – a Look at Professional Ethics (6 lectures and 3 tutorials for practice session)

Lecture 23 : Natural Acceptance of Human Values
Lecture 24 : Definitiveness of (Ethical) Human Conduct
Tutorial 12: Practice Session PS12 Exploring Ethical Human Conduct
Lecture 25 : A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order
Lecture 26 : Competence in Professional Ethics
Tutorial 13: Practice Session PS13 Exploring Humanistic Models in Education
Lecture 27: Holistic Technologies, Production Systems and Management Models-Typical Case Studies
Lecture 28 : Strategies for Transition towards Value-based Life and Profession
Tutorial 14: Practice Session PS14 Exploring Steps of Transition towards Universal Human Order

Practice Sessions:

UNIT – I: Introduction to Value Education

PS1 Sharing about Oneself
PS2 Exploring Human Consciousness
PS3 Exploring Natural Acceptance

UNIT – II: Harmony in the Human Being

PS4 Exploring the difference of Needs of self and body
PS5 Exploring Sources of Imagination in the self
PS6 Exploring Harmony of self with the body

UNIT – III: Harmony in the Family and Society

PS7 Exploring the Feeling of Trust
PS8 Exploring the Feeling of Respect
PS9 Exploring Systems to fulfil Human Goal

UNIT – IV: Harmony in the Nature (Existence)

PS10 Exploring the Four Orders of Nature
PS11 Exploring Co-existence in Existence

UNIT – V: Implications of the Holistic Understanding – a Look at Professional Ethics

PS12 Exploring Ethical Human Conduct
PS13 Exploring Humanistic Models in Education
PS14 Exploring Steps of Transition towards Universal Human Order

Readings:

Text Book and Teachers Manual

a. The Textbook: R R Gaur, R Asthana, and G P Bagaria, "A Foundation Course in Human Values and Professional Ethics", 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1

b. The Teacher's Manual: R R Gaur, R Asthana, and G P Bagaria, "Teachers' Manual for A Foundation Course in Human Values and Professional Ethics", 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2

Reference Books

1. A Nagaraj, "JeevanVidya: EkParichaya", JeevanVidya Prakashan, Amarkantak, 1999.
2. A. N. Tripathi, "Human Values", New Age International Publishers, 2004.
3. Annie Leonard, "The Story of Stuff", Free Press Publishers, 2010.
4. Mohandas Karamchand Gandhi, "The Story of My Experiments with Truth", 1st Edition, Fingerprint Publishers, 2009.
5. E. F Schumacher, "Small is Beautiful", Vintage Publishers, 2010.
6. Cecile Andrews , "Slow is Beautiful", New Society Publishers, 2006.
7. J C Kumarappa, "Economy of Permanence", Sarva Seva Sangh Prakashan, 2017.
8. Pandit Sunderlal, "Bharat Mein Angreji Raj", Publications Division, M/O Information & Broadcasting, Govt. of India, 2016.
9. Dharampal,"Rediscovering India", Stosius Inc/Advent Books Division, 1983.
10. Mohandas K. Gandhi, "Hind Swaraj or Indian Home Rule", 15th Edition, Educa Books, 2011.
11. Maulana Abdul Kalam Azad, "India Wins Freedom", 1st Edition, Orient BlackSwan, 1988.
12. Romain Rolland, "Life of Vivekananda", 4th Impression Edition, Advaita Ashrama press, 2010.
13. Romain Rolland, "Mahatma Gandhi**",** Maple Press , 2010.

Mode of Conduct:

Lecture hours are to be used for interactive discussion, placing the proposals about the topics at hand and motivating students to reflect, explore and verify them.

Tutorial hours are to be used for practice sessions.

While analyzing and discussing the topic, the faculty mentor's role is in pointing to essential elements to help in sorting them out from the surface elements. In other words, help the students explore the important or critical elements.

In the discussions, particularly during practice sessions (tutorials), the mentor encourages the student to connect with one's own self and do self-observation, self-reflection and self exploration.

Scenarios may be used to initiate discussion. The student is encouraged to take up ”ordinary” situations rather than” extra-ordinary” situations. Such observations and their analyses are shared and discussed with other students and faculty mentor, in a group sitting.

Tutorials (experiments or practical) are important for the course. The difference is that the laboratory is everyday life, and practical are how you behave and work in real life. Depending on the nature of topics, worksheets, home assignment and/or activity are included. The practice sessions (tutorials) would also provide support to a student in performing actions commensurate to his/her beliefs. It is intended that this would lead to development of commitment, namely behaving and working based on basic human values.

It is recommended that this content be placed before the student as it is, in the form of a basic foundation course, without including anything else or excluding any part of this content. Additional content may be offered in separate, higher courses. This course is to be taught by faculty from every teaching department, not exclusively by any one department.

Teacher preparation with a minimum exposure to at least one 8-day Faculty Development Program on Universal Human Values is deemed essential.

e-Learning Resources:

1. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%201Introduction%20to%20Value%20Education.pdf
2. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%202-Harmony%20in%20the%20Human%20Being.pdf
3. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%203-Harmony%20in%20the%20Family.pdf
4. https://fdp-si.aicte-india.org/UHV%201%20Teaching%20Material/D3S2%20Respect%20July%2023.pdf
5. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%205-Harmony%20in%20the%20Nature%20and%20Existence.pdf
6. https://fdp-si.aicte-india.org/download/FDPTeachingMaterial/3-days%20FDPSI%20UHV%20Teaching%20Material/Day%203%20Handouts/UHV%203D%20D3-S2A%20Und%20Nature-Existence.pdf
7. https://fdp-si.aicteindia.org/UHV%20II%20Teaching%20Material/UHV%20II%20Lecture%202325%20Ethics%20v1.pdf
8. https://www.studocu.com/in/document/kiet-group-of-institutions/universal-humanvalues/chapter-5-holistic-understanding-of-harmony-on-professional-ethics/62490385
9. https://onlinecourses.swayam2.ac.in/aic22_ge23/preview

NUMERICAL TECHNIQUES AND STATISTICAL METHODS

II Year – II Semester

Lecture : 3	Internal Marks : 30
Credits : 3	External Marks : 70

Course Objectives:

- To elucidate the different numerical methods to solve engineering problems.
- To familiarize the students with the foundations of probability and statistical methods.

Course Outcomes:

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

- obtain numerical solutions for different engineering problems using iterative methods and interpolate given data.
- evaluate integrals numerically and solve ordinary differential equations.
- apply discrete and continuous probability distributions in various engineering applications.
- construct sampling distributions, confidence intervals and to find maximum error of estimates for population parameters.
- infer the statistical inferential methods based on small and large sampling tests.

Course Content

UNIT – I: Iterative Methods

Introduction: Solutions of algebraic and transcendental equations: Bisection Method –Method of false position–Iteration method–Newton-Raphson method (One variable)

Interpolation: Newton's forward and backward formulae for interpolation–Interpolation with un equal intervals–Lagrange's interpolation formula

UNIT–II: Numerical integration, Solution of ordinary differential equations with initial conditions

Trapezoidal rule– Simpson's $1/3^{rd}$and $3/8^{th}$ rule– Solution of initial value problems by Taylor's series– Picard's method of successive approximations– Euler's method –Runge- Kutta method (second and fourth order) – Milne's Predictor and Corrector Method.

UNIT–III: Probability and Distributions

Baye's theorem–Random variables–Discrete and Continuous random variables–Distribution functions–Probability mass function, Probability density function and Cumulative distribution functions – Mathematical Expectation and Variance – Binomial, Poisson, Uniform and Normal distributions.

UNIT–IV: Sampling Theory

Introduction – Population and Samples – Sampling distribution of Means and Variances (definition only) –Point and Interval estimations – Maximum error of estimate – Central limit theorem (without proof) – Estimation using t, chi-square and F-distributions.

UNIT–V: Tests of Hypothesis

Introduction – Hypothesis – Null and Alternative Hypothesis – Type I and Type II errors – Level of significance– One tail and two-tail tests – Test of significance for large samples and Small Samples: Single and difference of means – Single and two proportions – Student's t- test, F-test, chi-square test.

Text Books:

1. B. S. Grewal "Higher Engineering Mathematics" 44^{th} Edition, Khanna Publishers.

2. Miller and Freund's "Probability and Statistics for Engineers" 7th Edition, Pearson, 2008.

Reference Books:

1. Steven C. Chapra "Applied Numerical Methods with MATLAB for Engineering and Science" Tata Mc. Graw Hill Education.
2. M. K. Jain, S.R.K. Iyengar and R.K. Jain "Numerical Methods for Scientific and Engineering Computation" New Age International Publications.
3. Lawrence Turyn "Advanced Engineering Mathematics" CRC Press.

ENGINEERING GEOLOGY

II Year – II Semester

Lecture : 3	Internal Marks : 30
Credits : 3	External Marks : 70

Course Objectives:

- To know the importance of Engineering Geology to the Civil Engineering.
- To impart the knowledge on minerals and rocks.
- To highlight significance and importance of Structural Geology.
- To familiarize with concepts of Groundwater, Earthquakes, Land Slides and geophysical methods.
- To create awareness on selection of site for Dams, Reservoirs and Tunnels.

Course Outcomes:

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

- understand the significance of geological agents on Earth surface and its significance in Civil Engineering.
- identify and understand the properties of Minerals and Rocks.
- explains the basics of Structural Geology.
- understand the concepts of Groundwater, geophysical methods & classify and measure the Earthquake prone areas, Landslides and subsidence to practice the hazard zonation.
- investigate the project site for mega/mini civil engineering projects and site selection for mega engineering projects like Dams, Reservoirs and Tunnels.

Course Content

UNIT - I:

Introduction: Branches of Geology, Importance of Geology in Civil Engineering with case studies, Geological agents, Weathering of rocks, weathering process of Rock, Rivers and geological work of rivers.

UNIT - II:

Mineralogy And Petrology: Definitions of mineral and rock-Different methods of study of mineral. Physical properties of minerals and rocks for megascopic study for the following minerals and rocks. Common rock forming minerals: Feldspar, Quartz Group, Olivine, Augite, Hornblende, Mica Group, Asbestos, Talc, Chlorite, Kyanite, Garnet, Calcite and ore forming minerals are Pyrite, Hematite, Magnetite, Chlorite, Galena, Pyrolusite, Graphite, Chromite, Magnetite and Bauxite. Classification, structures, textures and forms of Igneous rocks, Sedimentary rocks, Metamorphic rocks, and their megascopic study of granite varieties, (pink, gray, green). Pegmatite, Dolerite, Basalt etc., Shale, Sand Stone, Lime Stone, Laterite, Quartzite, Gneiss, Schist, Marble, Khondalite and Slate.

UNIT – III:

Structural Geology: Strike, Dip and Outcrop study of common geological structures associating with the rocks such as Folds, Faults, Joints and Unconformities- parts, types, mechanism and their importance in Civil Engineering.

UNIT – IV:

Ground Water: Water table, Cone of depression, Geological controls of Ground Water Movement, Ground Water Exploration Techniques.

Earthquakes and Land Slides: Terminology, Classification, causes and effects, Shield areas and Seismic bells, Richter scale intensity, Precautions of building constructions in seismic areas.

Classification of Landslides, Causes and Effects, measures to be taken prevent their occurrence at Landslides.

Geophysics: Importance of Geophysical methods, Classification, Principles of Geophysical study by Gravity method, Magnetic method, Electrical methods.

UNIT – V:

Geology of Dams, Reservoirs and Tunnels: Types and purpose of Dams, Geological considerations in the selection of a Dam site. Geology consideration for successful constructions of reservoirs, Life of Reservoirs. Purpose of Tunnelling, effects, Lining of Tunnels. Influence of Geology for successful Tunnelling.

Text Books:

1. N. Chenna Kesavulu "Engineering Geology" 2nd Edition, Laxmi Publications, 2014.
2. Parbin Singh Katson educational series "Engineering & General Geology" 8th Edition, 2023.

Reference Books:

1. Subinoy Gangopadhay "Engineering Geology" 1st Edition, Oxford University press 2012.
2. D. Venkat Reddy "Engineering Geology" 2nd Edition, Vikas Publishing, 2017.
3. Alan E Kehew "Geology for Engineers and Environmental Society" 3rd Edition, Pearson publications 2013.

e-Learning Resources:

1. http://nptel.iitm.ac.in/video.php?subjectId=105105106
2. http://nptel.iitm.ac.in/video.php?courseId=1055&p=1
4. http://nptel.iitm.ac.in/video.php?courseId=1055&p=3
5. http://nptel.iitm.ac.in/video.php?courseId=1055&p=4

CONCRETE TECHNOLOGY

II Year – II Semester

Lecture : 3	Internal Marks : 30
Credits : 3	External Marks : 70

Course Objectives

- To impart knowledge on materials and their properties used in the production of concrete.
- To assess the behavior of concrete at fresh stage.
- To understand the behavior of concrete at hardened stage.
- To learn the influence of elasticity, creep and shrinkage on concrete.
- To know the mix design methodology and special concretes.

Course Outcomes:

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

- familiarize with the basic ingredients of concrete and their role in the production of concrete and its behaviour in the field.
- test the fresh concrete properties and the hardened concrete properties. Understand the basic concepts of concrete and special concretes and their production and applications.
- evaluate the ingredients of concrete through lab test results. realise the importance of quality of concrete.
- understand the rheological behavior of concrete.
- design the concrete mix by BIS method.

Course Content

UNIT - I:

Cements: Portland cement – Chemical composition – Hydration, Setting of cement, Fineness of cement, Structure of hydrate cement – Test for physical properties – Different grades of cements – Admixtures – Mineral and chemical admixtures – accelerators, retarders, air entrainers, plasticizers, super plasticizers, fly ash and silica fume

Aggregates: Classification of aggregate – Particle shape & texture – Bond, strength & other mechanical properties of aggregates – Specific gravity, Bulk density, porosity, adsorption & moisture content of aggregate – Bulking of sand –Deleterious substances – Soundness – Alkali aggregate reaction – Thermal properties – Sieve analysis – Fineness modulus – Grading curves – Grading of fine & coarse Aggregates – Maximum aggregate size- Quality of mixing water

UNIT - II:

Fresh Concrete: Steps in Manufacture of Concrete–proportion, mixing, placing, compaction, finishing, curing – including various types in each stage. Properties of fresh concrete-Workability – Factors affecting workability – Measurement of workability by different tests, Setting times of concrete, Effect of time and temperature on workability – Segregation & bleeding – Mixing and vibration of concrete, Ready mixed concrete, Shotcrete

UNIT - III:

Hardened Concrete: Water / Cement ratio – Abram's Law – Gel/space ratio – Nature of strength of concrete –Maturity concept – Strength in tension & compression – Factors affecting strength – Relation between compression & tensile strength – Curing, Testing of Hardened Concrete: Compression test – Tension test – Factors affecting strength – Flexure test –Splitting test – Non-destructive testing methods – Codal provisions for NDT.

UNIT - IV:

Elasticity, Creep & Shrinkage – Modulus of elasticity – Dynamic modulus of elasticity – Poisson's ratio – Creep of concrete – Factors influencing creep – Relation between creep & time – Nature of creep – Effects of creep – Shrinkage –types of shrinkage.

UNIT - V:

Mix Design and Special Concretes: Ready mixed concrete, Fibre reinforced concrete – Different types of fibres – Factors affecting properties of FRC, High performance concrete – Self consolidating concrete, Self healing concrete. Factors in the choice of mix proportions – Quality control of concrete- Statistical methods- Acceptance Criteria-Concepts Proportioning of concrete mixes by ACI method and IS Code method

Text Books:

1. A.M. Neville "Properties of Concrete" 4th Edition, Pearson.
2. M.L. Gambhir "Concrete Technology" 5th Edition, Tata Mc. Graw Hill Publishers, New Delhi 2013.
3. Job Thomas "Concrete Technology" 1st Edition, Cengagae Publications, 2015.

References Books:

1. P.K. Mehta and Moterio "Concrete Microstructure, Properties of Materials" 4th Edition, McGraw Hill 2014.
2. J.J. Brooks and A. M. Neville "Concrete Technology" 2nd Edition, Pearson, 2019.
3. M. S. Shetty "Concrete Technology" 4th Edition, S. Chand & Co., 2004.

STRUCTURAL ANLAYSIS

II Year – II Semester

Lecture : 3	Internal Marks : 30
Credits : 3	External Marks : 70

Course Objectives

- To learn indeterminate structural analysis.
- To analyze fixed and continuous beams.
- To understand and Practice Slope - deflection method, moment distribution & Kani's method.

Course Outcomes:

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

- analyze indeterminate structures by different methods.
- analyze fixed and continuous beams.
- analyze continuous beams and portal frames by using Slope - Deflection method.
- analyze continuous beams and portal frames by using Moment - Distribution method.
- analyze continuous beams and portal frames by using Kani's method.

Course Content

UNIT – I

Energy Theorems: Introduction, strain energy due to axial load, bending moment and shear forces – Castigliano's first theorem Deflections of simple beams and pin jointed trusses, Indeterminate Structural Analysis – Determination of static and kinematic indeterminacies.

UNIT - II

Fixed Beams & Continuous Beams : Introduction to statically indeterminate beams with uniformly distributed load, central point load, eccentric point load, number of point loads, uniformly varying load, couple and combination of loads – Shear force and Bending moment diagrams – Deflection of fixed beams effect of sinking of support, effect of rotation of a support.

UNIT - III

Slope-Deflection Method: Introduction-derivation of slope deflection equations- application to continuous beams with and without settlement of supports - Analysis of single bay portal frames without sway.

UNIT - IV

Moment Distribution Method: Introduction to moment distribution method -Application to continuous beams with and without settlement of supports-Analysis of single bay storey portal frames without sway.

UNIT - V

Kani's Method: Introduction to kani's method - Application to continuous beams with and without settlement of supports-Analysis of single bay storey portal frames without sway.

Text Books:

1. V. N. Vazirani & M. M. Ratwani "Analysis of Structures – Vol-I & II" Khanna Publications, New Delhi.
2. C. S. Reddy "Basic Structural Analysis" 3rd Edition, Tata McGraw Hill Publishers, 2017.

Reference Books:

1. Aslam Kassimali "Structural analysis" 6th Edition, Cengage publications, 2020.
2. Dr. R. Vaidyanathan and Dr. P Perumal "Structural analysis Vol.I and II" 3rd Edition, Laxmi publications, 2016.
3. B. D. Nautiyal "Introduction to structural analysis" New Age international publishers, New Delhi.

HYDRAULICS AND HYRAULIC MACHINERY

II Year – II Semester

Lecture : 3	Internal Marks : 30
Credits : 3	External Marks : 70

Course Objectives:

- To introduce concepts of laminar and turbulent flows.
- To know principles of uniform flows through open channel.
- To teach principles of non-uniform flows through open channel.
- To impart knowledge on design of turbines.
- To impart knowledge on design of pumps.

Course Outcomes:

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

- analyse the characteristics of laminar and turbulent flows.
- apply the knowledge of fluid mechanics to address the uniform flow problems in open channels.
- solve non-uniform flow problems and hydraulic jump phenomenon in open channel flows.
- evaluate the performance of impact of jets on plates and design Pelton wheel, Francis turbine.
- evaluate the performance characteristics of pumps.

Course Content

UNIT – I

Laminar & Turbulent flow in pipes: Laminar Flow- Laminar flow through: circular pipes, annulus and parallel plates. Stoke‘s law, Measurement of viscosity. Reynolds experiment, Transition from laminar to turbulent flow. Resistance to flow of fluid in smooth and rough pipes-Moody‘s diagram – Introduction to boundary layer theory.

UNIT - II

Uniform flow in Open Channels: Open Channel Flow - Comparison between open channel flow and pipe flow, geometrical parameters of a channel, classification of open channels, classification of open channel flow, Velocity Distribution of channel section. Hydraulically efficient channel sections: Rectangular, trapezoidal and triangular channels, Energy and Momentum correction factors

UNIT - III

Non-Uniform flow in Open Channels: Specific energy, critical flow, discharge curve, Specific force, Specific depth, and Critical depth. Measurement of Discharge and Velocity – Gradually Varied Flow- Dynamic Equation of Gradually Varied Flow. Hydraulic Jump and classification - Elements and characteristics- Energy dissipation.

UNIT - IV

Impact of Jets: Hydrodynamic force of jets on stationary and moving flat, inclined and curved vanes - Velocity triangles at inlet and outlet - Work done and efficiency Hydraulic Turbines: Classification of turbines; pelton wheel and its design. Francis turbine and its design - efficiency - Draft tube: theory - characteristic curves of hydraulic turbines. Cavitation: causes and effects.

UNIT – V

Pumps: Working principles of a centrifugal pump, work done by impeller; heads, losses and efficiencies; minimum starting speed; Priming; specific speed; limitation of suction lift, net positive suction head (NPSH); Performance and characteristic curves; Cavitation effects; Multistage centrifugal pumps; troubles and remedies

Text Books:

1. P. M. Modi and S. M. Seth "Hydraulics and Fluid Mechanics" 22nd Edition, Standard Book House, 2019.
2. K. Subrahmanya "Theory and Applications of Fluid Mechanics" 2nd Edition, Tata McGraw Hill, 2018.

Reference Books:

1. R. K. Bansal "A text of Fluid mechanics and hydraulic machines" 11th Edition, Laxmi Publications (P) Ltd., New Delhi, 2024.
2. Frank M. White, Henry Xue "Fluid Mechanics" 9th Edition, Tata McGraw Hill, 2022.
3. C. S. P. Ojha, R. Berndtsson and P. N. Chadramouli "Fluid Mechanics and Machinery" Oxford University Press, 2010.

e-Learning Resources:

1. https://nptel.ac.in/courses/105105203https://archive.nptel.ac.in/courses/112/106/112106300/https://archive.nptel.ac.in/courses/112/103/112103249/

CONCRETE TECHNOLOGY LABORATORY

II Year – II Semester

Practice : 3	Internal Marks : 30
Credits : 1.5	External Marks : 70

Course Objectives

- To test the basic properties of ingredients of fresh and hardened concretes.

Course Outcomes:

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

- outline importance of testing cement and its properties.
- assess different properties of Aggregates.
- compare fresh concrete properties and their relevance to hardened concrete.
- evaluate hardened concrete properties.

List of Experiments:

(Perform any 10 of the following experiments)

1. **Tests on Cement**
   - Normal Consistency and Fineness of cement.
   - Initial setting time and Final setting time of cement.
   - Specific gravity and soundness of cement.
   - Compressive strength of cement.
2. **Tests on Fine Aggregates**
   - Grading and fineness modulus of Fine aggregate by sieve analysis.
   - Specific gravity of fine aggregate
   - Water absorption and Bulking of sand.
3. **Tests on Coarse Aggregates**
   - Grading of Coarse aggregate by sieve analysis.
   - Specific gravity of coarse aggregate
   - Water absorption of Coarse aggregates
4. **Tests on fresh Concrete**
   - Workability of concrete by compaction factor method
   - Workability of concrete by slump test
   - Workability of concrete by Vee-bee test.
5. **Tests on Hardened Concrete**
   - Compressive strength of cement concrete and Modulus of rupture Young's Modulus and Poisson's Ratio Split tensile strength of concrete.
   - Non-Destructive testing on concrete (for demonstration)

ENGINEERING GEOLOGY LABORATORY

II Year – II Semester

Practice : 3	Internal Marks : 30
Credits : 1.5	External Marks : 70

Course Objectives:

- To familiarize with the Megascopic types of Ore minerals & Rock forming minerals.
- To familiarize with the Megascopic types of Igneous, Sedimentary, Metamorphic rocks.
- To impart knowledge on the topography of the site & material selection.

Course Outcomes:

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

- identify Megascopic minerals & their properties.
- identify Megascopic rocks & their properties.
- understand the site parameters such as contour, slope & aspect for topography.
- know the occurrence of materials using the strike & dip problems.

List of Experiments:

1. Physical properties of minerals: Mega-scopic identification of
   a. Rock forming minerals – Quartz group, Feldspar group, Garnet group, Mica group & Talc, Chlorite, Olivine, Kyanite, Asbestos, Tourmelene, Calcite, Gypsum, etc…
   b. Ore forming minerals – Magnetite, Hematite, Pyrite, Pyralusite, Graphite, Chromite, etc.
2. Megascopic description and identification of rocks.
   a) Igneous rocks – Types of Granite, Pegmatite, Gabbro, Dolerite, Syenite, Granite Poryphery, Basalt, etc.
   b) Sedimentary rocks – Sand stone, Ferrugineous sand stone, Lime stone, Shale, Laterite, Conglamorate, etc.
   c) Metamorphic rocks – Biotite – Granite Gneiss, Slate, Muscovite & Biotiteschist, Marble, Khondalite, etc.
3. Interpretation and drawing of sections for geological maps showing tilted beds, faults, unconformities etc.
4. Simple Structural Geology problems.
5. Bore hole data.
6. Strength of the rock using laboratory tests.
7. Field work – To identify Minerals, Rocks, Geomorphology & Structural Geology.

Lab Examination Pattern:

1. Description and identification of FOUR minerals
2. Description and identification of FOUR (including igneous, sedimentary and metamorphic rocks)
3. ONE Question on Interpretation of a Geological map along with a geological section.
4. TWO Questions on Simple strike and Dip problems.
5. Bore hole problems.
6. Project report on geology.

Reference Books:

1. M T Mauthesha Reddy "Applied Engineering Geology Practicals" 2nd edition, New Age International Publishers.
2. Tony Waltham "Foundations of Engineering Geology" 3rd edition, Spon Press, 2009.

REMOTE SENSING & GEOGRAPHICAL INFORMATION SYSTEMS

II Year – II Semester

Tutorial : 1	Practice : 2	Internal Marks	: 30
Credits : 2		External Marks	: 70

Course Objectives:

- To understand the basic principles of Remote Sensing and GIS Applications and about the Satellites of Recent sensors.
- To learn various techniques for the Digital image Interpretation of a Satellite image.
- To introduce GIS software to understand the process of digitization, creation of thematic map from toposheets and maps.

Course Outcomes

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

- acquire knowledge about concepts of remote sensing, sensors and their characteristics.
- familiarize with data models and data structures to introduce various Raster and Vector Analysis capabilities in GIS.
- digitize and create thematic map and extract important features to calculate geometry.
- perform surface analysis over Contour to develop digital elevation model.
- use GIS software to perform simple analysis in water resources and transportation engineering.

Course Content

UNIT – I

Introduction to Remote sensing: History of Remote Sensing, Electromagnetic Radiation, Electromagnetic Spectrum, Energy Interaction with Atmosphere, Energy Interaction with the Earth Surfaces - Characteristics of Remote Sensing Systems, Sensor Resolutions, Advantages & Limitations - Platforms: Types of Sensors, Airborne Remote Sensing, Spaceborne Remote Sensing - IRS, LANDSAT, SPOT & Recent satellite.

UNIT – II

Digital Image analysis: Digital Image Characteristics, Digital Image Data Formats, Band Interleaved by Pixel (BIP), Band Interleaved by Line (BIL), Band Sequential (BSQ) - Visual Interpretation Elements, Preprocessing, Enhancement, Classification, Supervised classification, Unsupervised classification.

UNIT – III

Introduction to Geographic Information System: Principles, Components and Applications of GIS - Map projections, Spatial Data Structures, Raster and Vector Data Formats, Data Inputs, Data Manipulation, Data Retrieval, Data Analysis - Spatial data analysis: Overlay Function-Vector Overlay Operations, Raster Overlay Operations, Arithmetic Operators, Comparison and Logical Operators, Conditional Expressions - Network Analysis: Components of network, Transportation network - Optimum path analysis.

Text Books:

1. Basudeb Bhatta "Remote sensing and GIS" 3rd Edition, Oxford University Press, 2021.
2. S. Kumar "Basics of Remote sensing & GIS", Laxmi Publications, 2016.
3. Lillesand, T.M, R.W. Kiefer and J.W. Chipman "Remote Sensing and Image Interpretation", 7th Edition, Wiley India Pvt. Ltd., 2022.

List of Experiments:

Expt. 1 : Georeferencing a Toposheet or Map
Expt. 2 : Digitization and Attribute table creation.
Expt. 3 : Creation of Thematic Map

Expt. 4 : Calculation of Feature geometry – Length, Area & Perimeter.
Expt. 5 : Contour map – developing TIN & DEM from Contour.
Expt. 6 : Stream network – Stream ordering map.
Expt. 7 : Watershed - calculate Hydro-geomorphological parameters.
Expt. 8 : Transportation Network Map – Route analysis.

GIS SOFTWARE: QGIS / ArcGIS

Text book for Practical

1. QGIS User Guide
2. ArcGIS User Manual by ESRI

Reference Books:

1. Schowengerdt, R. A "Remote Sensing" Elsevier publishers, 2006.
2. Burrough P A and R.A. McDonnell "Principals of Geographical Information Systems" Oxford University Press, 1998.
3. George Joseph "Fundamentals of Remote Sensing" Universities Press, 2013.

Web references:

1. https://nptel.ac.in/courses/10510319

BUILDING MATERIALS AND CONSTRUCTION

II Year – II Semester

Lecture : 3	Internal Marks : 30
Credits : -	External Marks : 70

Course Objectives:

- To learn about the nature, properties, classification and manufacturing process of building materials and familiarize with various methods of masonry construction.
- To impart the knowledge of building components, finishings and alternate materials.

Course Outcomes:

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

- explain the importance of building materials.
- apply the knowledge on use of lime and cement in various constructions.
- know the knowledge on stones and rocks.
- learn the importance of building components, finishing's and types of bonds.
- evaluate importance and role of alternate materials.

Course Content

UNIT - I: Bricks and tiles

Introduction, Clay and its Classifications, Physical Properties of Clays, Bricks, Classification of Bricks, Characteristics of Good Brick, Ingredients of Good Brick Earth, Harmful Substances in Brick Earth, Manufacturing of Bricks, Different Forms of Bricks, Testing of Bricks, Defects of Bricks. Types of tiles and their use in buildings, Manufacturing process of tiles.

UNIT – II: Lime and Cement

IS classification of lime and uses, flow diagram of manufacturing process of lime and cements (dry and wet process), IS specifications and tests on Portland cement, different types of cements, lime and their uses, Various field and laboratory tests for cement.

UNIT - III: Rocks and Stones

Introduction Rock-forming Minerals, Classification of Rocks, Quarrying of Stones, Natural Bed of Stone, Seasoning of Stone, Dressing of Stone, Uses of Stones, Characteristics of good Building Stone, Testing of Stones, Deterioration of Stones, Durability of Stones, Preservation of Stones, Selection of Stones. Common Building Aggregates

UNIT - IV: Building Components and Finishings

Lintels, Arches, Vaults, Types of Stair cases; Different types of floors - Concrete, Mosaic and Terrazzo floors - Pitched, Flat and curved Roofs, Leanto-Roof; Coupled roofs, Trussed roofs- King and Queen Post Trusses, RCC flat and Shell roofs. Various types of bonds in masonary, English bond and Flemish bonds.

Damp proofing and Water proofing- materials used; Plastering, Pointing, Whitewashing and Distempering; Painting – Constituents of paints – Types paints; Painting of Wood Surface – Varnish – Form work and scaffolding

UNIT – V: Introduction to Some New Materials

Properties and applications of Galvanized Iron, Fibre-reinforced plastics, Steel, Aluminium, Glass, Gypsum, ceramics, fly ash. Ferro cement, super plasticizers, FAL-G brick, fly ash, plastics, paints, and geo-textiles

Text Books

1. S K Duggal "Building materials" 3rd Edition, New Age International Publishers.
2. B.C.Punmia, Ashok Kumar Jain and Arun Kumar Jain "Building Construction" 3rd Edition, Laxmi Publications (P) ltd., New Delhi.

Reference Books:

1. R.Chudly "Construction Technology Volumes I and II" 2nd Edition, Longman, UK, 1987.
2. S.C.Rangwala "Engineering Materials" 4th Edition, Charotar Publications.
3. SP-7:2016 National Building Code of India (NBC) 2016.

DESIGN AND DRAWING OF REINFORCED CONCRETE STRUCTURES

III Year – I Semester

Lecture : 3	Internal Marks : 30
Credits : 3	External Marks : 70

Course Objectives:

- To familiarize with the different types of design philosophies and IS: 456-2000 provisions.
- To introduce the concepts of shear, torsion, bond and limit state of collapse and serviceability for analysis and design of structural elements for flexure along with detailing and drawings.
- To enable the students to learn design of different compression members and footings.

Course Outcomes:

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

- explain the fundamental behaviour of RCC structures and utilize different ypes of design philosophies.
- analyze the beams subjected to shear, bond, torsion and serviceability.
- analyze and design the beams for flexure in limit state of collapse and serviceability.
- design the columns and footings with detailing.
- design the waist slab of stair case, one-way and two-ways labs for flexure in limit state of collapse and serviceability.

Course Content

UNIT – I:

Introduction: Working stress method Design codes and handbooks, loadingstandards – Dead, live, wind and earthquake loads, elastic theory, design constants, modular ratio, neutral axis depth and moment of resistance, balanced, under-reinforced and over-reinforced sections, working stress method of design of singly and doubly reinforced beams.

Limit State Design: Concepts of limit state design – Basic statistical principles – Characteristic loads –Characteristic strength – Partial load and safety factors – representative stress-strain curves for cold worked deformed bars and mild steel bars. Assumptions in limit state design – stress - block parameters – limiting moment of Resistance.

UNIT – II:

Design for Shear, Torsion and Bond: Limit state analysis and design of section for shear and torsion for L Beam – concept of bond, anchorage and development length, I.S. code provisions. Design examples in simply supported and continuous beams, detailing.

Limit state design for serviceability: Deflection, cracking and code provision.

UNIT – III:

Design for Flexure: Limit state analysis and design of singly reinforced sections- effective depth- Moment of Resistance- Doubly reinforced and flanged (T) beam sections- Minimum depth for a given capacity- Limiting Percentage of Steel- Minimum Tension Reinforcement- Maximum Flexural Steel- Design of Flanged Sections (T)- Effective width of flange –Behavior- Analysis and Design.

UNIT – IV:

Design of Compression Members: Effective length of a column, Design of short and long columns – under axial loads, uniaxial bending and biaxial bending – Braced and un-braced columns – I S Code provisions.

Footings: Different types of footings – Design of isolated footings, Square footings – Rectangular footings – circular footing – spread & sloped footings - subjected to axial loads.

UNIT – V

Slabs: Classification of slabs, design of one - way slabs, two - way slabs, and continuous slabs using IS Coefficients (conventional), design of waist-slab staircase.

NOTE: All the designs to be taught in Limit State Method. Drawing classes must be conducted every week and the Following plates should be prepared by the students.

- Reinforcement detailing of T-beams, L-beams and continuous beams and cantilevers.
- Reinforcement detailing of columns and isolated footings.
- Detailing of one-way, two-way and continuous slabs and waist-slab staircase.

Final Examination Pattern:

The end examination paper should consist of Part A and Part B. Part A consists of two questions in Design and Drawing out of which one question is to be answered. Part B should consist of five questions and design out of which three are to be answered. Weightage for Part – A is 40% and Part- B is 60%.

Text Books:

1. Limit State Design of Reinforced concrete, B.C. Punmia, Ashok Kumar Jain and Arun Kumar Jain, 2007, Laxmi Publications.
2. Design of Reinforced concrete Structures, S. Ramamrutham and R.Narayana, Dhanpat Rai publishing Co (P) Ltd. IS Codes : IS456 : 2000, IS 875 (Part I & II).

Reference Books:

1. Fundamentals of Reinforced concrete design by M.L. Gambhir, 3rd Edition, Prentice Hall of India Private Ltd.
2. Limit state design of reinforced concrete by P.C. Varghese, 2nd Edition, Prentice Hall of India Private Ltd.
3. Reinforced concrete design by S. Unni krishna Pillai & Devdas Menon, 3rd Edition, Tata Mc. Graw Hill, New Delhi.

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ENGINEERING HYDROLOGY

III Year – I Semester

Lecture : 3	Internal Marks : 30
Credits : 3	External Marks : 70

Course Objectives:

- To understand the hydrologic cycle and its significance in civil engineering, including key physical processes, interrelationships, and methods for measuring and estimating its components.
- To interpret and apply hydrographs, flood frequency analysis, and flood estimation techniques for hydrological analysis and water resources design.
- To comprehend groundwater flow principles and apply well hydraulics concepts to analyze subsurface water behaviour in civil engineering applications.

Course Outcomes:

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

- apply the fundamental theories and principles that govern hydrologic processes**, c**onstruct Intensity-Duration-Frequency (IDF) and Depth-Area-Duration (DAD) curves for the design of hydraulic structures.
- quantify the abstractions from precipitation; analyze their influencing factors and control or reduction strategies.
- determine runoff from a catchment using hydrologic methods and develop a unit hydrograph and synthetic hydrograph to predict runoff response for any given rainfall event.
- estimate flood magnitude using hydrologic methods and perform flood routing to analyze the movement of flood waves through channels and reservoirs.
- evaluate the hydraulic properties of an aquifer, including transmissivity, hydraulic conductivity and yield of a well.

Course Content

UNIT – I:

Introduction: Engineering hydrology and its applications, Hydrologic cycle, hydrological data-sources of data.

Precipitation: Types and forms, measurement, introduction to radar measurement of rain fall, rain gauge network, presentation of rainfall data, average rainfall, continuity and consistency of rainfall data, frequency of rainfall, Intensity-Duration-Frequency (IDF) curves, Depth-Area-Duration (DAD) curves, Probable Maximum Precipitation (PMP), design storm

UNIT – II:

Abstractions: Initial abstractions, Evaporation: factors affecting, measurement, estimation, reduction, Evapotranspiration: factors affecting, measurement, estimation, control, Infiltration: factors affecting, Infiltration capacity curve, measurement, infiltration indices.

UNIT – III:

Runoff: Factors affecting runoff, components, empirical formulae, tables and curves, stream gauging, rating curve, flow mass curve and flow duration curve.

Hydrograph analysis: Components of hydrograph, separation of base flow, effective rainfall hyetograph and direct runoff hydrograph, unit hydrograph, assumptions, derivation of unit hydrograph, unit hydrographs of different durations, principle of superposition and S-hydrograph methods, limitations and applications of unit hydrograph, dimensionless unit hydrograph, synthetic unit hydrograph, introduction to IUH.

UNIT – IV:

Floods: Causes and effects, frequency analysis- Gumbel's and Log-Pearson type III distribution methods, Standard Project Flood (SPF) and Probable Maximum Flood (MPF), flood control methods and management.

Flood Routing: Hydrologic routing, channel and reservoir routing-Muskingum and Puls methods of routing.

UNIT – V:

Groundwater: Occurrence, types of aquifers, aquifer parameters, porosity, specific yield, permeability, transmissivity and storage coefficient, types of wells, Darcy's law, Dupuit's equation- steady radial flow to wells in confined and unconfined aquifers, yield of an open well-recuperation test.

Text Books:

1. 'Engineering Hydrology' by Subramanya, K, Tata McGraw-Hill Education Pvt Ltd, (2013).
2. 'Engineering Hydrology' by Jayarami Reddy. P, Laxmi Publications Pvt. Ltd., (2013).

Reference Books:

1. 'Water Resources Engineering' by Larry W. Mays, Wiley India Pvt. Ltd, (2013).
2. 'Hydrology' by Raghunath. H.M., New Age International Publishers, Pvt Ltd (2010).
3. 'Irrigation and water power engineering' by B.C. Punmia, Pande B.B Lal, Ashok Kumar Jain & Arun Kumar Jain, Laxmi Publications Pvt. Ltd., (2009).

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SOIL MECHANICS

III Year – I Semester

Lecture : 3	Internal Marks : 30
Credits : 3	External Marks : 70

Course Objectives:

- To equip students with the skills to determine the index properties of soil, classify it, and understand the principles of seepage, including water discharge through soils.
- To impart knowledge of soil compaction, consolidation, and shear strength, enabling students to analyze consolidation settlement and determine shear parameters for sands and clays.

Course Outcomes:

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

- know soil formation and determine soil index properties and classification.
- explain soil moisture and flow of water through soils and estimate pressures at various depth.
- recognize Seepage through soils and calculate stresses under loading conditions.
- understand the principles of compaction & consolidation and compute the consolidation settlements
- estimate soil strength parameters using different shear tests with respect to the drainage conditions

Course Content

UNIT – I:

Introduction: Soil formation – Structure of Soils – Texture of Soils – Three phase system and phase relationships.

Index Properties and Classification Tests of Soils: Index properties – Density Index - Grain size analysis – Sieve and Hydrometer methods – Consistency of Clay Soils – Activity of Clays – Thixotropy of clays - soil Classification – Unified soil classification and I.S. Soil classification.

UNIT – II:

Soil moisture and Capillarity: Soil moisture and modes of occurrence – Total, Neutral and Effective Pressures – Capillary Rise in soils.

Permeability: Flow of water through soils – One dimensioned flow of water through soils – Darcy's law – permeability – Factors affecting – laboratory determination of coefficient of permeability – Permeability of layered systems.

UNIT – III:

Seepage and Flow Nets: Flow net for one-dimensional flow – two-dimensional flow – Basic equation for Seepage – Flow nets & Characteristics and Uses – Quicksand condition – Seepage forces

Stress Distribution in Soils: Stresses induced by applied loads – Boussinesq's and Westergaard's theories for point loads and areas of different shapes – Newmark's influence chart – 2:1 stress distribution method – Pressure Blubs.

UNIT – IV:

Compaction: Mechanism of compaction – factors affecting – effects of compaction on soil properties – compaction control.

Consolidation: Compressibility of soils – e-p and e-log p curves – Stress history – Concept of consolidation – Spring Analogy – Terzaghi's theory of one-dimensional Consolidation – Time rate of consolidation and degree of consolidation – Determination of coefficient of consolidation (c_v) – Over consolidated and normally consolidated clays.

UNIT – V:

Shear Strength of Soils: Basic mechanism of shear strength-Mohr – Coulomb Failure theories – total and effective shear strength parameters – Stress-Strain behavior of Sands-Critical Void Ratio – Stress-Strain behavior of clays – Shear Strength determination- various drainage conditions – stress paths.

Text Books:

1. Soil Mechanics and Foundation Engineering by Dr. K.R. Arora, Standard Publishers and Distributors, New Delhi.
2. 'Soil Mechanics and Foundation Engineering' by V.N.S.Murthy ,CBS publishers

Reference Books:

1. 'Fundamentals of Soil Mechanics' by D. W. Taylor., Wiley.
2. Basic and Applied Soil Mechanics by Gopal Ranjan and A.S.R.Rao, New Age International Publishers.
3. 'Geotechnical Engineering' by C. Venkataramaiah, New Age International Publishers.

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Professional Elective – I:

ADVANCED STRUCTURAL ANALYSIS

III Year – I Semester

Lecture : 3	Internal Marks : 30
Credits : 3	External Marks : 70

Course Objectives:

- To introduce the analysis of indeterminate structures using Castigliano's I and II theorems, along with the application of approximate methods for multi-storey building frames.
- To familiarize with the analysis of various structural elements, including 2-hinged and 3-hinged arches, cables, suspension bridges, and portal frames using Moment Distribution and Kani's methods.

Course Outcomes:

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

- differentiate Determinate and Indeterminate Structures
- carryout Lateral Load analysis of structures
- analyze Cable and Suspension Bridge structures
- analyze the structures using Moment Distribution and Kani's Methods
- analyze the structures using Matrix methods

Course Content

UNIT - I

Energy Theorems: Introduction - Strain energy in linear elastic system, expression of strain energy due to axial load, bending moment and shear forces - Castigliano's first theorem- Deflections of simple beams and pin jointed plane trusses.

Indeterminate Trusses: Determination of static and kinematic indeterminacies – Analysis of trusses having single and two degrees of internal and external indeterminacies – Castigliano's second theorem.

UNIT – II:

Three Hinged Arches: Elastic theory of arches - Eddy's theorem - Determination of horizontal thrust, bending moment, normal thrust and radial shear - effect of temperature - Hinges with supports at different levels.

Two Hinged Arches: Determination of horizontal thrust, bending moment, normal thrust and radial shear - Rib shortening and temperature stresses, Tied arches - Fixed arches - (No analytical question)

UNIT – III:

Approximate Methods of Analyses: Application to building frames. (i) Portal Method (ii) Cantilever Method (iii) Substitute frame method for approximate analysis of multi-storey frames subjected to gravity loads and lateral loads. Shear force and bending moment diagrams - Elastic curve

UNIT – IV:

Cable Structures and Suspension Bridges: Introduction, characteristics of cable, analysis of cables subjected to concentrated and uniformly distributed loads, anchor cable, temperature stresses, analysis of simple suspension bridge, three hinged and two hinged stiffening girder suspension bridges.

UNIT – V:

Moment Distribution Method: Analysis of Portal frames including Sway - Substitute frame analysis by two cycle - Analysis of inclined frames - Shear force and bending moment diagrams - Elastic curve.

Kani's Method: Analysis of continuous beams – including settlement of supports and single bay portal frames with and without side sway - Shear force and bending moment diagrams - Elastic curve.

Text Books:

1 Structural Analysis by R.C. Hibbeler, Pearson, New Delhi.

2 Analysis of Structures- Vol. I and II, V. N. Vazirani and M. M. Ratwani, Khanna Publishers, New Delhi.

Reference Books:

1 Mechanics of Structures Vol. II by H.J. Shah and S.B. Junnarkar, Charotar Publishing House Pvt. Ltd.

2 Structural Analysis - A Matrix Approach by G.S. Pandit and S.P. Gupta, Mc Graw Hill Pvt. Ltd.

3 Intermediate Structural Analysis, Chu-Kia Wang, Tata McGraw Hill Publishers, 2017.

4 Structural Analysis, R C Hibbeler, Pearson, 2017.

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

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Professional Elective – I:

GOUND IMPROVEMENT TECHNIQUES

III Year – I Semester

Lecture : 3	Internal Marks : 30
Credits : 3	External Marks : 70

Course Objectives:

- To appreciate the need for various ground improvement methods, including in-situ densification, dewatering, and the use of geotextiles and geosynthetics to enhance soil properties.
- To understand the concepts, applications, and effects of grouting, reinforced earth technology, and soil nailing as alternatives to conventional retaining walls.

Course Outcomes:

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

- possess the knowledge of various methods of ground improvement and their suitability to different field situations using mechanical modifications.
- explain ground modifications by dewatering methods
- identify modifications due to Admixture stabilization and the concepts with applications of grouting.
- explain reinforced earth technology and ground anchors.
- know the various functions of Confinement systems & Geosynthetics and their applications in Civil Engineering practice.

Course Content

UNIT – I:

Introduction to Ground Modification: Need and objectives of Ground Improvement, Classification of Ground Modification Techniques – suitability and feasibility, Emerging Trends in ground improvement.

Mechanical Modification: Methods of compaction, Shallow compaction, Deep compaction techniques – Vibro-floatation, Blasting, Dynamic consolidation, pre-compression and compaction piles, Field compaction control.

UNIT – II:

Hydraulic Modification: Methods of dewatering – open sumps and ditches, Well-point system, Electro-osmosis, Vacuum dewatering wells; pre-loading without and with sand drains, strip drains and rope drains, vertical drains.

UNIT – III:

Admixture Stabilization: Stabilisation with admixtures like cement, lime, calcium chloride, fly ash and bitumen

Grouting: objectives of grouting – grouts and their applications – methods of grouting – stage of grouting–hydraulic fracturing in soils and rocks –post grout tests.

UNIT – IV:

Reinforced Earth Technology: Concept of soil reinforcement, reinforcing materials, backfill criteria, art of reinforced earth technology, design and construction of reinforced earth structures, soil nailing.

Ground Anchors: Types of ground anchors and their suitability, Uplift capacity of anchors.

UNIT – V:

Geo-materials Confinement Systems: Concept of confinement, Gabion walls, Crib walls, Sand bags, Fabric form work.

Geosynthetics: geotextiles – types – functions, properties and applications – geogrids, geomembranes and gabions - properties and applications.

Text Books:

1. 'Engineering principles of ground modification' by Manfred R. Haussmann, Pearson Education Inc. New Delhi, 2008.
2. 'Ground Improvement Techniques' by Purushotham Raj, Laxmi Publications, New Delhi.

Reference Books:

1. 'Ground Improvement 'by MP Moseley, Blackie Academic and Professional, USA.
2. 'Designing with Geosynethetics 'by RM Koerner, Prentice Hall.
3. 'An introduction to Soil Reinforcement and Geosynthetics' by G.L. Siva Kumar Babu, Universities Press.
4. 'Ground Improvement Techniques' by Nihar Ranjan Patro,Vikas Publishing House(p) limited, New Delhi.

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Professional Elective – I:

CONSTRUCTION TECHNOLOGY AND MANAGEMENT

III Year – I Semester

Lecture : 3	Internal Marks : 30
Credits : 3	External Marks : 70

Course Objectives:

- To introduce the concepts of project management, including network diagrams, scheduling techniques, and the use of computerized scheduling systems, along with their limitations and advantages.
- To familiarize with the interpretation of key laws and regulations, including labor laws, tax laws, and national and international guidelines relevant to construction projects.
- To introduce various construction equipment and machinery, and the importance of construction methods and Building Information Modeling (BIM) in improving project efficiency and execution.

Course Outcomes:

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

- appreciate importance of construction planning
- construct WBS and compute critical path, slack and floats for a given network diagram.
- understand the functioning of various earthmoving equipment
- create scheduling for material, equipment and manpower requirements to execute the project.
- apply the knowledge gained on construction methods and BIM

Course Content

UNIT – I:

Introduction: Construction project management and its relevance – qualities of a project manager – project planning – coordination –scheduling - monitoring – bar charts – milestone charts – critical path method, milestone charts, work break down structure and preparation of networks. Network Techniques like PERT, CPM- CPM- total float, free float, Interfering Float, and Independent Float.

Precedence diagram in construction management- Types of Relationships- Start to Start relationship, Finish to Start relationship, Finish to Finish relationship, Start to Finish relationship.

UNIT – II:

Cost analysis: Project cost, Indirect & direct project cost, slope of direct cost curve, total project cost and optimum duration, steps in time cost optimization, cost analysis-updating–crashing for optimum cost–crashing for optimum resources–allocation of resources introduction to software's for construction management, project management using PRIMAVERA (or) equivalent.

UNIT – III:

Labour and Material Utilization & Cost Estimation

Labour requirements, labour productivity, Equipment, Material Management, Inventory Control, Economic order quantity, EOQ for resource limitation, Resource scheduling - leveling and allocation.

Costs Associated with Constructed Facilities - Construction Cost Estimates - Historical Cost Data - Cost Indices - Applications of Cost Indices to Estimating - Estimate based on Engineer's List of Quantities - Estimation of Operating Costs.

UNIT – IV:

Construction equipment – Earth Moving operations-Types of Earthwork Equipment - Tractors, Motor Graders, Scrapers, Front end Loaders, Earth Movers – capacity calculations.

Forklifts and related equipment - Portable Material Bins - Conveyors - equipment used in demolition – Chain Pulley Blocks. Crushers – Feeders - Screening Equipment - Batching and Mixing

Factors affecting selection of equipment and methods –Planning - Equipment Management in Projects - Maintenance Management – Replacement - Cost Control of Equipment – Depreciation Analysis, Methods of calculation of depreciation- Safety Management

UNIT – V:

Construction methods – earthwork – piling – placing of concrete – form work – fabrication and erection – quality control and safety engineering.

BIM for Civil Engineers (Building Information Modelling) - Introduction – Parametric modeling – Visualization – Completion of building modeling – 4D simulation using Navis works – Navigation and Clash detection

Text Books:

1. Punmia B. C., Ashok Kumar Jain, Arun Kumar Jain, (2017), Building Construction, 11th Edition, Lakshmi Publications, New Delhi.
2. Robert L. Peurifoy, Clifford J. Schexnayder, Aviad Shapira (2010), Construction Planning, Equipment and Methods, Indian Edition ,Mc-Graw Hill-Education, New Delhi

Reference Books:

1. Kumar NeerajJha, (2015), Construction Project Management, 2nd Edition, Pearson, New Delhi.
2. Varghese P.C., (2012), Foundation Engineering, PHI Learning Private Limited, New Delhi.
3. Construction Management Emerging Trends and Technologies' by Trefor Williams , Cengage learning
4. Prasanna Chandra, (2017), Project Planning, Analysis, Selection, Implementation and Review, 8th Edition, McGraw-Hill, New Delhi.
5. 'Construction Technology' by Subir K. Sarkarand Subhajit Sarasvati, Oxford University press.

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Professional Elective – I:

ADVANCED SURVEVING TECHNIQUES

III Year – I Semester

Lecture : 3	Internal Marks : 30
Credits : 3	External Marks : 70

Course Objectives:

- To know the significance of advanced surveying in field measurements in terms of utility and precision of data collection.
- To learn the principles of Electromagnetic distance measurement and their accuracy.
- To get introduced to the concept of Topographic, Aerial and project survey.

Course Outcomes:

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

- explain the process of EDM in distance measurement and traversing.
- analyse the concept of Topographic survey.
- understand the concepts of Aerial survey.
- apply different concepts in project survey.
- outline the GPS in transportation engineering, structural engineering and land use planning.

Course Content

UNIT – I: Electromagnetic Distance Measurement (EDM)

Introduction – Electromagnetic waves – Basic definitions – distance from measurement of Transit Time – Measurement of Distance from Phase Difference – Electro-optical EDM instruments – Infrared EDM Instruments – Microwave EDM Instruments.

UNIT – II: Topographic Surveying

Scales of Maps – Planning a Topographic Survey –Methods of Establishing Horizontal Control – Establishing Vertical Control – Instruments for location of details.

UNIT – III: Aerial Survey

Aerial Photograph – Definitions – Scale of Vertical Photograph – Scale of Tilted Photograph – displacements and Errors in Aerial Photogrammetry – Procedure of Aerial Survey.

UNIT – IV: Project Surveying

Detailed surveys – Horizontal Control – Vertical Control – Survey of a Bridge – Survey of a Dam – Survey of a Tunnel – Capacity of a Reservoir.

UNIT – V: Global Positioning System

Introduction – System Design Considerations – GPS System elements – Calcu- lation of User position – DGPS – applications of GPS in Civil Engineering.

Text Books:

1. Surveying by Duggal S.K., Vol. II,3rd Edition, Tata McGraw Hill.
2. Remote Sensing and Geographical Information Systems by M. Anji Reddy, 4th Edition B.S. Publications.
3. Surveying by Arora, K. R., Vol. III, Standard Book House, 2010.

Reference Books:

1. Remote Sensing and GIS by Basudeb Bhatta,2nd Edition, Oxford University Press
2. Global Positioning System by Satheesh Gopi, Tata McGraw, 2005

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Open Elective – I:

GREEN BUILDINGS

III Year – I Semester

Lecture : 3	Internal Marks : 30
Credits : 3	External Marks : 70

Course Objectives:

- To understand the principles of green building practices and explore sustainable practices in habitat, urbanization, and industrialization.
- To identify and analyze local and global environmental issues, and investigate renewable energy sources and green technologies as solutions.
- To learn about tools and frameworks for environmental management and their application in promoting sustainability.

Course Outcomes:

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

- explain key sustainability models and principles in engineering contexts.
- assess impacts of pollution, climate change, and waste on sustainability.
- apply EMS, LCA, and EIA tools in real-world sustainability case studies.
- evaluate sustainable design and material choices in built environments.
- demonstrate knowledge of alternative energy sources and green business practices.

Course Content

UNIT – I: Introduction

What is Green Building, Why to go for Green Building, Benefits of Green Buildings, Green Building Materials and Equipment in India, What are key Requisites for Constructing a Green Building, Important Sustainable features for Green Building,

UNIT – II: Green Building Concepts and Practices

Indian Green Building Council, Green Building Moment in India, Benefits Experienced in Green Buildings, Launch of Green Building Rating Systems, Residential Sector, Market Transformation; Green Building Opportunities And Benefits: Opportunities of Green Building, Green Building Features, Material and Resources, Water Efficiency, Optimum Energy Efficiency, Typical Energy Saving Approach in Buildings, LEED India Rating System and Energy Efficiency,

UNIT – III: Green Building Design

Introduction, Reduction in Energy Demand, Onsite Sources and Sinks, Maximise System Efficiency, Steps to Reduce Energy Demand and Use Onsite Sources and Sinks, Use of Renewable Energy Sources. Ecofriendly captive power generation for factory, Building requirement,

UNIT – IV:

Air Conditioning Introduction, CII Godrej Green business centre, Design philosophy, Design interventions, Energy modeling, HVAC System design, Chiller selection, pump selection, Selection of cooling towers, Selection of air handing units, Precooling of fresh air, Interior lighting system, Key feature of the building. Eco-friendly captive power generation for factory, Building requirement.

UNIT – V: Material Conservation

Handling of non process waste, waste reduction during construction, materials with recycled content, local materials, material reuse, certified wood, Rapidly renewable building materials and furniture; Indoor Environment Quality And Occupational Health: Air conditioning, Indore air quality, Sick building syndrome, Tobacco smoke control, Minimum fresh air requirements avoid use of asbestos in the building, improved fresh air ventilation, Measure of IAQ, Reasons for poor IAQ, Measures to achieve Acceptable IAQ levels,

Text Books:

1. Dr. Mili Majumdar - Green Building: A Guide for Sustainable Development, TERI (The Energy and Resources Institute) Publications, India, Ist Edition, 2015
2. Dr. Satish Kumar & Dr. Rakesh Kumar - Energy Efficiency in Buildings, TERI (The Energy and Resources Institute) Publications, India , Ist Edition, 2018

Reference Books:

1. Charles J. Kibert - Sustainable Construction: Green Building Design and Delivery, Wiley Publishers, 5th Edition, 2022
2. Jerry Yudelson - Green Building A to Z: Understanding the Language of Green Building, New Society Publishers, 1st Edition, 2007.
3. Audrey Levitin & Daniel Williams - Sustainable Design: Ecology, Architecture, and Planning, Wiley Publishers, 1st Edition, 2007.
4. K.S. Jagadish - Alternative Building Materials and Technologies , New Age International Publishers,2nd Edition, 2018

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Open Elective – I:

CLIMATE CHANGE IMPACT ON ECO-SYSTEM

III Year – I Semester

Lecture : 3	Internal Marks : 30
Credits : 3	External Marks : 70

Course Objectives:

- To provide a scientific understanding of the Earth's climate system, its variability, and the physical processes influencing climate and weather patterns.
- To analyze the hydrological and ecological impacts of climate change through the study of climate variables, extreme weather events, and predictive climate models.

Course Outcomes:

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

- explain the structure of the atmosphere, radiative energy transfer, and the thermal dynamics influencing Earth's climate system.
- illustrate the components of the hydrologic cycle and apply basic models to analyze water balance in the context of climate dynamics.
- analyze climate variables such as precipitation, humidity, and wind circulation, and their impact on atmospheric and hydrological processes.
- identify and evaluate the causes and impacts of climate variability and extreme weather events such as floods, droughts, and heat waves.
- demonstrate an understanding of climate change modeling, interpret IPCC climate scenarios, and assess projected climate impacts using GCMs and downscaling techniques.

Course Content

UNIT – I: Climate System

Climate, weather and Climate Change; Overview of Earth’s Atmosphere; Vertical Structure of Atmosphere; Radiation and Temperature; Laws of Radiation; Heat-Balance of Earth Atmosphere System; Random Temperature Variation; Modelling Vertical Variation in Air Temperature; Temporal Variation of Air temperature; Temperature Change in Soil; Thermal Time and Temperature Extremes.

UNIT – II: Hydrologic Cycle

Introduction; Global water balance; Cycling of water on land, a simple water balance model;

UNIT – III: Climate Variables affecting Precipitation

Precipitation and Weather, Humidity, Vapor Pressure, Forms of Precipitation, Types of Precipitation; Cloud; Atmospheric Stability; Monsoon; Wind Pattern in India; Global Wind Circulation; Evaporation and Transpiration, Processes of Vadose Zone, Surface Runoff, Streamflow

UNIT – IV: Climate Variability

Floods, Droughts, Drought Indicators, Heat waves, Climate Extremes.

UNIT – V: Climate Change

Introduction; Causes of Climate Change; Modeling of Climate Change, Global Climate Models, General Circulation Models, Downscaling; IPCC Scenarios

Text Books:

1. **Raghunath, H.M.** (2006). Hydrology: Principles, Analysis, and Design. New Age International Publishers.
2. **Barry, R.G. & Chorley, R.J.** (2009). Atmosphere, Weather and Climate (9th ed.). Routledge.

Reference Books:

1. **IPCC (2021).** Climate Change 2021: The Physical Science Basis. Intergovernmental Panel on Climate Change.
2. **Peixoto, J.P. & Oort, A.H.** (1992). Physics of Climate. American Institute of Physics.
3. **Brutsaert, W.** (2005). Hydrology: An Introduction. Cambridge University Press.

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GEOTECHNICAL ENGINEERING LAB

III Year – I Semester

Practical : 3	Internal Marks : 30
Credits : 1.5	External Marks : 70

Course Objectives:

- To impart knowledge of determination of index properties required for classification of soils.
- To teach how to determine compaction characteristics and consolidation behavior from relevant lab tests;
- To teach how to determine shear parameters of soil through different laboratory tests.

Course Outcomes:

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

- determine index properties of soil and classify them, permeability of soils.
- determine Compaction, Consolidation and shear strength characteristics.

Course Content

List of Experiments

At least TEN experiments shall be conducted.

1. Determine the specific gravity (G) of soil
2. Determine Atterberg's Limits
3. Determine the field density of soil using the core cutter and sand replacement methods.
4. Determine the grain size distribution of soil through sieving.
5. Determine the permeability of soil using constant and variable head tests.
6. Determine the compaction characteristics of soil through IS compaction test.
7. Consolidation properties of soil through a consolidation test (Demo)
8. Determine the Laboratory California Bearing Ratio (CBR)
9. Determine the shear strength of soil using the direct shear test.
10. Determine the shear strength parameters through the triaxial compression test.
11. Determine the unconfined compressive strength of soil through the unconfined compression test.
12. Determine the shear strength of cohesive soils using the vane shear test.
13. Determine the Differential Free Swell (DFS) of soil
14. Bearing capacity of soil using the field plate load test (Demo)
15. Field California Bearing Ratio (Demo)

Reference Books:

1. 'Determination of Soil Properties 'by J.E.Bowles.
2. IS Code 2720 –relevant parts

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FLUID MECHANICS & HYDRAULIC MACHINES LAB

III Year – I Semester

Practical : 3	Internal Marks : 30
Credits : 1.5	External Marks : 70

Course Objectives:

- To provide fundamental knowledge on the measurement of fluid flow in closed conduits, tanks, and open channels.
- To develop a practical understanding of the operating principles of various hydraulic machines through laboratory experimentation.
- To verify key principles of open channel flow and analyze the performance characteristics of different hydraulic machines by constructing performance curves.

Course Outcomes:

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

- calculate discharge through pipe systems under various flow conditions.
- measure discharge in open channels using appropriate hydraulic methods.
- determine major and minor losses in pipe flow systems.
- construct velocity diagrams for jet impact on vanes and analyze resulting forces.
- plot and interpret performance curves for hydraulic turbines and pumps

Course Content:

List of Experiments:

At least TEN experiments shall be conducted.

1. Verification of Bernoullis' equation.
2. Calibration of Venturimeter.
3. Calibration of Orificemeter.
4. Determination of coefficient of discharge of a small orifice by constant head method
5. Determination of coefficient of discharge of an external cylindrical mouth piece by variable head method.
6. Calibration of a contracted rectangular notch.
7. Calibration of a triangular notch.
8. Determination of friction factor of the pipe material.
9. Determination of coefficient of head loss due to a sudden expansion/contraction in a pipeline.
10. Determination of head loss coefficient due to a bend in pipeline.
11. Determination of efficiency of jet on vanes
12. Determination of efficiency of Pelton wheel turbine.
13. Determination of efficiency of Francis turbine
14. Determination of efficiency of single stage centrifugal pump.
15. Determination of efficiency of reciprocating pump

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TINKERING LAB

III Year – I Semester

Practical : 2	Internal Marks : 30
Credits : 1	External Marks : 70

The aim of tinkering lab for engineering students is to provide a hands-on learning environment where students can explore, experiment, and innovate by building and testing prototypes. These labs are designed to demonstrate practical skills that complement theoretical knowledge.

Course Objectives:

- To encourage Innovation and Creativity
- To provide Hands-on Learning
- To impart Skill Development
- To foster Collaboration and Teamwork
- To enable Interdisciplinary Learning
- To impart Problem-Solving mind-set
- To prepare for Industry and Entrepreneurship.

Course Outcomes:

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

- experiment, innovate, and solve real-world challenges.

These labs bridge the gap between academia and industry, providing students with the practical experience. Some students may also develop entrepreneurial skills, potentially leading to start-ups or innovation-driven careers. Tinkering labs aim to cultivate the next generation of engineers by giving them the tools, space, and mind-set to experiment, innovate, and solve real-world challenges.

Course Content:

List of Experiments:

1. Make your own parallel and series circuits using breadboard for any application of your choice.
2. Demonstrate a traffic light circuit using breadboard.
3. Build and demonstrate automatic Street Light using LDR.
4. Simulate the Arduino LED blinking activity in Tinkercad.
5. Build and demonstrate an Arduino LED blinking activity using Arduino IDE.
6. Interfacing IR Sensor and Servo Motor with Arduino.
7. Blink LED using ESP32.
8. LDR Interfacing with ESP32.
9. Control an LED using Mobile App.
10. Design and 3D print a Walking Robot
11. Design and 3D Print a Rocket.
12. Build a live soil moisture monitoring project, and monitor soil moisture levels of a remote plan in your computer dashboard.
13. Demonstrate all the steps in design thinking to redesign a motor bike.

e-Learning Resources:

1. https://aim.gov.in/pdf/equipment-manual-pdf.pdf
2. https://atl.aim.gov.in/ATL-Equipment-Manual/
3. https://aim.gov.in/pdf/Level-1.pdf
4. https://aim.gov.in/pdf/Level-2.pdf
5. https://aim.gov.in/pdf/Level-3.pdf

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SKILLS ON CIVIL ENGINEERING SOFTWARE (CAD & REVIT)

III Year – I Semester

Practical : 2	Tutorial : 1	Internal Marks	: 30
Credits : 2		External Marks	: 70

Course Objectives:

- To impart proficiency in creating, modifying, and managing 2D and 3D drawings for civil engineering projects using modern CAD software.
- To develop competency in structural modeling, analysis, and design of building components using appropriate structural engineering software.
- To enable students to interpret, generate, and detail structural drawings according to standards and codes.
- To familiarize students with GIS software applications for data processing, spatial analysis, and mapping relevant to civil engineering.

Course Outcomes:

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

- prepare and modify 2D and 3D architectural and structural drawings using CAD software for civil projects.
- analyze and design basic structural elements and building systems using modern structural analysis/design software.
- interpret and apply industry codes, detailing standards, and best practices for structural drawings and documentation.
- utilize GIS tools to process spatial data, create maps, and perform relevant analyses for civil engineering applications.

List of Experiments:

Perform any 10 of the following experiments

Part – A (using Auto Cad/Revit/Prog Cad or any relevant software)

1. Creating and Modifying 2D Drawings in AutoCAD: Basics of drawing lines, circles, and other shapes and Creating and Editing Layers in AutoCAD: Understanding layer management for better drawing organization.
2. Preparation of Structural Drawings for a G+3 Residential Building in AutoCAD: Generating structural layouts, including columns, beams, and slab details for a G+2 building.
3. Designing and Modifying Staircase Layout for G+1 or G+2 Buildings in AutoCAD: Create a staircase 2D plan with detailed dimensions.
4. Creating a G+2 Residential Building Model in Revit: Generate a full 3D model of a G+2 residential building, including walls, floors, roofs, and openings.
5. Creating Detailed 3D Elevation and Section Views for a Residential Building in Revit: Generate detailed 3D elevations and sections of a G+2 residential building.
6. Drafting a Foundation Plan for a Multi-Story Building in AutoCAD: Create a foundation plan that includes footing details, slab thickness, and material specifications for a multi-story building.
7. Creating a Structural Steel Detailing Plan in AutoCAD: Generate detailed drawings for structural steel components such as beams, columns, and connections for a commercial building.
8. Modelling a Complex Building in Revit: Model a building with multiple elements like curved walls, slopes, and different floor levels, focusing on advanced Revit tools.

Part – B (using STAAD Pro / E-Tabs / CYPE or any other relevant software)

1. Analyze and design any type of determinate structure
2. Analyze and design any continuous beam
3. Analyze and design of a Compression Member
4. Analyze and design any portal frame without sway
5. Analyze and design any portal frame with sway
6. Analyze a simple truss
7. Design of a frame against Wind loads.
8. Design of a frame against earthquake loads

Part – C: (using ARC GIS/QGIS or any relevant software)

1. Creation of AOI, Clip and Mosaic (Satellite Imagery or Toposheet)
2. Digitization of Satellite Map/Toposheet and Creation of thematic maps
3. Calculate Geometry for vector data.
4. Developing Digital Elevation model from contours.
5. Catchment and stream delineation from DEM using QGIS
6. Supervised classification.

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Honors Degree

INTRODUCTION TO EARTHQUAKE ENGINEERING

III Year – I Semester

Lecture : 3	Internal Marks : 30
Credits : 3	External Marks : 70

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Course Objectives

- To provide coherent concepts on dynamic loading, earthquake mechanism and earthquake effects.
- To introduce concepts on structural dynamics, formation of equation of motion for single and multi-degree freedom systems and obtaining natural frequencies and mode shapes.
- To impart knowledge on elastic and inelastic analyses against earthquake forces.
- To familiarize on base isolation systems, seismic dampers and other special topics related to Eearthquake Engineering.

Course Outcomes

Upon successful completion of the course, the students will be able to

- gain experience in acquiring knowledge on earthquake inputs and their effects.
- understand the basics of structural dynamics and to calculate frequencies and mode shapes.
- explain the Earthquake design philosophy and apply the musing Seismic coefficient method and Response spectrum method.
- develop knowledge on elastic & inelastic analyses and ductility requirements.
- summarize the concepts on base isolation systems, seismic dampers and other special topics related to earthquake engineering.

Course Content

UNIT – I: Dynamic Loads and Basics of Seismology

Static loads Vs. Dynamic loads, Types of dynamic loads, Structure of Earth,Plate tectonics, E.Q. Rebound theory, Measurement of Earthquake, Seismic waves, Seismic Zones and Earthquake effects.

UNIT – II: Dynamics for Earthquake Analysis

Theory of vibrations - Simple Harmonic Motion, Equation of motion for Single Degree of Freedom (SDOF) system and Multi-Degrees of Freedom (MDOF) system - Un-damped forced vibrations of SDOF and MODF systems, frequencies and mode shapes - Orthogonality relationship.

UNIT – III: Analysis of Structures against Earthquake Forces and Ductitlity Detailing

Earthquake Design Philosophy - Seismic coefficient method and response spectrum method, provisions of IS 1893 (part I), Fundamental concepts of inelastic response analysis against earthquake forces - Push over analysis, Ductility detailing as per IS13920 code.

UNIT – IV: Base Isolation and Seismic Dampers

Concept of Base Isolation, Isolation systems and their modelling, Seismic damp- ers and Energy reducing meters.

UNIT – V: Special Topics

Dynamics of soils during earthquake motion, Soil liquefaction under seismic loads, Structural control & Seismic strengthening, Seismic hazard analysis.

Text Books:

1. "Basics of structural Dynamics and Aseismic Design", S. R. Damodarasamy and S. Kavitha, PHI Publications, NewDelhi.
2. "Earthquake Resistant Design of Structures", S. K. Duggal, Oxford University Press, New Delhi.
3. I. S Codes: IS1893 (PartI) and IS13920.

Reference Books:

1. "Earthquake Resistant Design of Structures", Pankaj Agarwal and Manish Shrikhande, PHI, 2008, NewDelhi.
2. "Dynamics of Structures", Clough & Penzin.
3. "Earthquake Engineering for Structural Design", Victor Gioncu and Febericon M, Spon Press, London & NewYork.
4. SP22 (1982) Explanatory Handbook on Codes of Earthquake Engineering, BIS New Delhi.

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Honors Degree

COMPUTER APPLICATIONS IN CIVIL ENGINEERING

III Year – I Semester

Practical : 3	Internal Marks : 30
Credits : 1.5	External Marks : 70

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Course Objectives

- To familiarize with programming languages to solve the civil engineering Problems.
- To introduce the concept of designing structures by using software.
- To impart the knowledge on Arc GIS software in solving civil engineering Problems.

Course Outcomes

Upon successful completion of the course, the students will be able to

- develop a program for solving a simple civil engineering problems.
- design an RC structural element by using software.
- apply Arc GIS techniques to solve civil engineering problems.

List of Experiments:

(Perform any 10 of the following experiments)

PART – A: Write any Four Programs Using C or C++

1. Design a Reinforced beam for flexure by Limit state method.
2. Design a T beam by Limit state method.
3. Design of one-way slab.
4. Design of Two-way slab.
5. Design of RCC compression member.

PART – B: Analyze and Design any four of the following Elements using STAAD Pro / E-TABS

1. Analyze and design any type of determinate structure.
2. Analyze and design any continuous beam.
3. Analyze and design of a Compression Member.
4. Analyze and design any portal frame without sway.
5. Analyze and design any portal frame with sway.

PART – C: Exercise any four of the following GIS Experiments

1. Creation of AOI, Clip and Mosaic (Satellite Imagery or Toposheet).
2. Digitization of Satellite Map/Toposheet and Creation of thematic maps.
3. Calculate Geometry for vector data.
4. Developing Digital Elevation model from contours.
5. Catchment and stream delineation from DEM using QGIS.

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FOUNDATION ENGINEERING

III Year – II Semester

Lecture : 3	Internal Marks : 30
Credits : 3	External Marks : 70

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Course Objectives

- To introduce the soil exploration techniques.
- To familiarize with slope stability and lateral earth pressure.
- To impart the knowledge on load carrying capacity of shallow and deep foundations.

Course Outcomes

Upon successful completion of the course, the students will be able to

- choose suitable type of boring and generate soil investigation report.
- analyze stability of slopes and lateral earth pressure for different soil mediums
- calculate bearing capacity of shallow foundations.
- estimate pile and pile group capacity for any kind of soils including group efficiency
- adopt proper construction and remedial measures of well foundations.

Course Content

UNIT – I:

Soil Exploration: Need – Methods of soil exploration – Boring and Sampling methods – Standard Penetration Test– Plate load test – Pressure meter – planning of Programme and preparation of soil investigation report.

UNIT – II:

Slope Stability: Infinite and finite earth slopes – types of failures – factor of safety of infinite slopes – stability analysis by Swedish arc method - Taylor's Stability Number.

Lateral Earth Pressure: Rankine's theory - Active and passive earth pressure for cohesionless and cohesive soils - Earth pressure at rest - Coloumb's wedge theory

UNIT – III:

Shallow Foundations: Principle of design of footing, bearing capacity– criteria for determination of bearing capacity– factors influencing bearing capacity– analytical methods to determine bearing capacity– Terzaghi, and IS code methods. Bearing capacity based on N-Value.

UNIT – IV:

Pile Foundation: Classification of piles – Load carrying capacity of piles based on static pile formulae– Pile load tests - Load carrying capacity of pile groups in sands and clays.

UNIT – V:

Well Foundation: Different shapes of well foundations –Forces acting on well foundation– Design of individual Components– Construction and sinking of well foundations – Tilts and shifts.

Text Books:

1. 'Soil Mechanics and Foundation Engineering' by Dr. K.R. Arora, Standard Publishers and Distributors, New Delhi.
2. 'Principles of Foundation Engineering' by Das, B.M., - (2011) –6th edition (Indian edition) Cengage learning

Reference Books:

1. 'Soil Mechanics and Foundation Engineering' by V.N.S.Murthy ,CBS publishers
2. 'Foundation Analysis and Design' by Bowles, J.E., (1988) – 4th Edition, McGraw-Hill Publishing Company, New York.
3. 'Foundation Engineering' by P.C Varghese, 9th Edition, PHI publishing Pvt. Ltd.

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HIGHWAY ENGINEERING

III Year – II Semester

Lecture : 3	Internal Marks : 30
Credits : 3	External Marks : 70

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Course Objectives

- To impart different concepts in the field of Highway Engineering.
- To acquire design principles of Highway Geometrics and Pavements
- To acquire design principles of Intersections.

Course Outcomes

Upon successful completion of the course, the students will be able to

- plan highway network for a given area.
- design highway geometrics of an alignment.
- conduct traffic flow studies and determine basic characteristics of traffic stream.
- characterize the pavement materials and design a bituminous mix.
- design a flexible and rigid pavement using IRC.

Course Content

UNIT – I: Highway Planning and Alignment

Highway development in India; Classification of Roads; Road Network Patterns; Necessity for Highway Planning; Different Road Development Plans – First, second, third road development plans, road development vision 2021, Rural Road Development Plan – Vision 2025; Planning Surveys; Highway Alignment- Factors affecting Alignment – Engineering Surveys – Drawings and Reports.

UNIT – II: Highway Geometric Design

Importance of Geometric Design – Design controls and Criteria – Highway Cross Section Elements – Sight Distance Elements – Stopping Sight Distance, Overtaking Sight Distance and Intermediate Sight Distance – Design of Horizontal Alignment – Design of Super elevation and Extra widening – Design of Transition Curves –Design of Vertical Alignment – Gradients – Vertical curves.

UNIT – III: Traffic Engineering

Basic Parameters of Traffic – Volume, Speed and Density – Traffic Volume Studies; Speed studies – spot speed and speed & delay studies; Parking Studies; Road Accidents-Causes and Preventive measures – Condition Diagram and Collision Diagrams; PCU Factors, Capacity of Highways – Factors Affecting; LOS Concepts; Road Traffic Signs; Road markings; Types of Intersections; At-Grade Intersections – Design of Plain, Flared, Rotary and Channelized Intersections; Design of Traffic Signals – Webster Method – IRC Method.

UNIT – IV: Highway Materials

Subgrade soil: classification –Group Index – Subgrade soil strength – California Bearing Ratio – Modulus of Subgrade Reaction. Stone aggregates: Desirable properties – Tests for Road Aggregates – Bituminous Materials: Types – Desirable properties –Tests on Bitumen – Bituminous paving mixes: Requirements – Marshall Method of Mix Design

UNIT – V: Design of Pavements

Types of pavements; Functions and requirements of different components of pavements; Design Factors

Flexible Pavements: Design factors – Flexible Pavement Design Methods – CBR method –IRC method – Burmister method – Mechanistic method – IRC Method for Low volume Flexible pavements.

Rigid Pavements: Design Considerations – wheel load stresses – Temperature stresses – Frictional stresses – Combination of stresses – Design of slabs – Design of Joints – IRC method – Rigid pavements for low volume roads – Continuously Reinforced Cement Concrete Pavements – Roller Compacted Concrete Pavements.

Text Books:

1. Highway Engineering, Khanna S. K., Justo C. E. G and Veeraragavan A, Nem Chand Bros., Roorkee.
2. Traffic Engineering and Transportation Planning, Kadiyali L. R, Khanna Publishers, New Delhi.

Reference Books:

1. Principles of Highway Engineering, Kadiyali L.R, Khanna Publishers, New Delhi
2. Principles of Transportation Engineering, Partha Chakraborty and Animesh Das, PHI Learning Private Limited, Delhi
3. Transportation Engineering and Planning, Papacostas C. S. and Prevedouros P. D, Prentice Hall, New Jersey

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ENVIRONMENTAL ENGINEERING

III Year – II Semester

Lecture : 3	Internal Marks : 30
Credits : 3	External Marks : 70

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Course Objectives

- To develop an understanding of the fundamental concepts and design principles related to water supply and wastewater engineering.
- To equip students with the skills to analyze water quality, estimate demands, and design appropriate water and wastewater treatment systems.
- To create awareness about environmental regulations, public health concerns, and sustainable practices in the management of water resources and sewage.

Course Outcomes

Upon successful completion of the course, the students will be able to

- estimate water demand and select suitable water sources for public water supply systems.
- analyze water quality and design appropriate water distribution networks
- identify and apply suitable water treatment processes based on water characteristics.
- design sewerage systems and primary treatment units considering flow and material requirements
- choose and implement suitable secondary treatment and disposal methods with environmental safety

Course Content

UNIT – I:

Introduction: Importance and Necessity of Protected Water Supply systems. Water borne diseases. Planning of public water supply systems. Per capita demand and factors influencing it, types of water demands and its variations, factors affecting water demand, Design Period, Factors affecting the Design period, estimation of water demand for a town or city, Population Forecasting.

Sources of Water: Various surface and subsurface sources considered for water supply and their comparison- Types of Pipes and Pipe joints.

UNIT – II:

Quality and Analysis of Water: Physical, Chemical and Biological characteristics of water. Water quality criteria for different uses- Rural, Municipal, Industrial and Agricultural uses. Drinking water quality standards: IS and WHO guidelines.

Distribution of Water: Requirements- Methods of Distribution system, Layouts of Distribution networks, Pressures in the distribution layouts, Analysis of Distribution networks: Equivalent pipe methods – Appurtenances of water distribution system.

UNIT – III:

Treatment of Water: Typical treatment flow of a municipal water treatment plant, Unit operations of water treatment: Theory of Sedimentation, Coagulation, flocculation, Filtration, Water conditioning and softening, Disinfection, Removal of color and odors – Removal of Iron and manganese – Fluoridation and De-fluoridation –Ion Exchange - Ultra filtration- Reverse Osmosis.

UNIT – IV:

Planning and Design of Sewerage System: Characteristics and composition of sewage — population equivalent -Sanitary sewage flow estimation — Sewer materials — Hydraulics of flow in sanitary sewers —Storm runoff estimation — sewer appurtenances — corrosion in sewers.

Primary Treatment of Sewage: Objectives — Unit Operations and Processes — Selection of treatment processes — Primary treatment — Principles, functions and design of sewage treatment units — screens — grit chamber-primary sedimentation tanks

UNIT – V:

Secondary Treatment of Sewage: Objectives — Selection of Treatment Methods — Principles, Functions, — Activated Sludge Process and Extended aeration systems -Trickling filters–Waste Stabilization Ponds —Reclamation and Reuse of sewage

Disposal of Sewage: Standards for– Disposal — Methods — dilution — Mass balance principle — Self purification of river - Oxygen sag curve — de-oxygenation and re-aeration — Streeter–Phelps model

Text Books

1. B.C. Punmia, A.K. Jain and A.K. Jain.- Water Supply Engineering, Laxmi Publications (P) Ltd., New Delhi, 2nd Edition, 2016
2. B.C. Punmia, A.K. Jain and A.K. Jain –Waste Water Engineering, Laxmi Publications (P) Ltd., New Delhi, 2nd edition, 2016
3. Howard S. Peavy, Donald R. Rowe, Teorge George Tchobanoglus- Environmental Engineering, McGraw-Hill Book Company, New Delhi, Reprint 2017

Reference Books

1. Santosh Kumar Garg- Environmental Engineering (Vol – I), Khanna Publishers, New Delhi,35th Edition, 2023
2. Santosh Kumar Garg - Environmental Engineering (Vol – II), Khanna Publishers, New Delhi, 30th Edition, 2023
3. Metcalf & Eddy , Wastewater Engineering: Treatment and Resource Recovery, McGraw-Hill Education, New delhi, 5th Edition, 2014
4. Water and Wastewater Technology by Mark J. Hammer Sr. & Jr, Publisher Pearson New International, 7th Edition, 2013.

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Professional Elective – II

FINITE ELEMENT ANALYSIS

III Year – II Semester

Lecture : 3	Internal Marks : 30
Credits : 3	External Marks : 70

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Course Objectives

- To ddetermine the stress in a truss element and assemblage of beam stiffness matrices
- To Develop the finite element solutions for plain stress and plain strain problems
- To Formulate the Iso parametric elements, shape functions and stress computation

Course Outcomes

Upon successful completion of the course, the students will be able to

- develop finite element formulations of 1degree of freedom problems and solve them
- understand any Finite Elements of ware to perform stress, thermal and modal analysis
- compute the stiffness matrices of different elements and system
- interpret displacements, strains and stress resultants
- analyze planar structural systems using finite element modeling

Course Content

UNIT – I: Introduction

Review of stiffness method-Principle of Stationary potential energy-Potential energy of anelastic body - Rayleigh-Ritz method of functional approximation-variational approaches- weighted residual methods.

UNIT – II: Finite Element Formulation of Truss Element

Stiffness matrix-properties of stiffness matrix–Selection of approximate displacement functions-solution of a plane truss-transformation matrix and stiffness matrix for a 3-D truss- Inclined and skewed supports-Galerkin's methodfor1-D truss– Computation of stress in a truss element.

UNIT – III: Finite Element Formulation of Beam Elements

Beam stiffness - assemblage of beam stiffness matrix- Examples of beam analysis for concentrated and distributed loading- Galerkin's method -2D arbitrarily oriented beam element–inclined and skewed supports–rigid plane frame examples

UNIT – IV:

Finite element formulation for plane stress, plane strain and axi symmetric problems-Derivation of CST and LST stiffness matrix and equations-treatment of body and surface forces-Finite Element solution for plane stress and axi-symmetric problems-comparison of CST and LST elements– convergence of solution-interpretation of stresses.

UNIT – V: ISO-Parametric Formulation

ISO-parametric bar element- plane bilinear Iso-parametric element – quadratic plane element-shape functions, evaluation of stiffness matrix, consistent modal load vector- Gauss quadrature-appropriate order of quadrature–element and mesh instabilities–spurious zero energy modes, stress computation-patch test.

Text Books:

1. A first course in the Finite Element Method–Dary lL. Logan, Thomson Publications.
2. Concepts and applications of Finite Element Analysis–Robert D. Cook, Michael E Plesha, John Wiley & Sons Publications

Reference Books:

1. Introduction to Finite Elements in Engineering Tirupati R. Chandrupatla, Ashok D. Belgundu, PHI publications.
2. Finite Element Method: Its Basic and Fundamentals, O.C. Zeinkiewicz, Butterworth Heinemann, 2007, 6th Edition.
3. Introduction To Finite Element Method, J. N. Reddy, McGraw Hill Pub., 2020, 4th Edition
4. Finite Element Analysis: Theory and Programming, C Krishnamoorthy, McGraw Hill Pub., 2017, 2nd Edition.

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Professional Elective – II

STRUCTURAL REPAIR AND REHABILITATION TECHNIQUES

III Year – II Semester

Lecture : 3	Internal Marks : 30
Credits : 3	External Marks : 70

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Course Objectives

- To provide in-depth knowledge of advanced materials, techniques, and evaluation methods used in the repair and rehabilitation of concrete structures.
- To familiarize students with modern strengthening and stabilization strategies using fiber-reinforced polymers and high-performance concretes.
- To develop analytical skills for selecting appropriate repair methodologies based on structural conditions, performance requirements, and durability considerations.

Course Outcomes

Upon successful completion of the course, the students will be able to

- evaluate materials and non-destructive testing methods for assessing damage in concrete structures due to corrosion, moisture, and thermal effects.
- apply suitable strengthening and stabilization techniques for structural elements such as beams, columns, and connections based on design requirements.
- analyze bonded installation techniques, FRP systems, and liquefaction impacts for structural strengthening and retrofitting.
- design and evaluate various types of fiber-reinforced and lightweight concretes, including mix proportions and durability characteristics.
- assess the development, properties, and applications of high-performance and self-consolidating concretes for modern structural applications.

Course Content

UNIT – I: Materials

Materials for repair and rehabilitation-Admixtures-types of admixtures-purposes of using admixtures-chemical composition-Natural admixtures-Fibers-wraps-Glass and Carbon fiber wraps-Steel Plates-Nondestructive evaluation - Importance - Concrete behavior under corrosion, disintegrated mechanisms - moisture effects and thermal effects -Visual investigation-Acoustical emission methods-Corrosion activity measurement- chloride content-Depth of carbonation-Impact echo methods-Ultra sound pulse velocity methods- pull out tests.

UNIT – II: Strengthening Techniques

Strengthening and stabilization-Techniques-design considerations-Beam shear capacity strengthening- Shear Transfer strengthening-stress reduction techniques- Column strengthening-flexural strengthening-Connection stabilization and strengthening, Crack stabilization

UNIT – III: Installation Techniques

Bonded installation techniques - Externally bonded FRP - Wetlay upsheet, bolted plate, near surface mounted FRP, fundamental debonding mechanisms – intermediate crack debonding-CDC debonding-plate end de bonding-strengthening of floor of structures post grout tests. Introduction to Liquefaction& its effects & applications.

UNIT – IV: Advanced Materials

Fiber reinforced concrete-Properties of constituent materials-Mix proportions, mixing and

casting methods-Mechanical properties of fiber reinforced concrete-applications of fiber reinforced concretes-Light weight concrete-properties of light weight concrete-No fines concrete-design of light weight concrete-Fly ash concrete-Introduction-classification of fly ash-properties and reaction mechanism of fly ash-Properties of fly ash concrete in fresh state and hardened state-Durability of fly ash concretes

UNIT – V: High Performance Concrete

High performance concretes-Introduction-Development of high performance concretes-Materials of high performance concretes-Properties of high performance concretes-Self Consolidating concrete-properties-qualifications.

Text Books

1. Maintenance Repair Rehabilitation & Minor works of Buildings by P.C. Varghese, PHI Publications
2. Repair and Rehabilitation of Concrete Structures by P.I. Modi, C.N. Patel, PHI Publications

Reference Books

1. Handbook on Repair and Rehabilitation of RC Buildings published by CPWD, Delhi
2. Concrete Structures - Repair, Rehabilitation and Retrofitting by B. Bhattacharjee, CRS Publishers and Distributors, 2017
3. Concrete Structures - Protection, Repair and Rehabilitation by R. Dodge Woodson, Elsevier, 2009
4. Concrete Chemical Theory and Applications by Santa Kumar A.R., Indian Society for Construction Engineering and Technology, Madras

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Professional Elective – II

WATER RESOURCES ENGINEERING

III Year – II Semester

Lecture : 3	Internal Marks : 30
Credits : 3	External Marks : 70

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Course Objectives

- To provide a comprehensive understanding of irrigation systems, including soil-water-plant relationships, crop water requirements, and the application of appropriate irrigation methods.
- To understand the design principles of non-erodible and erodible canals, as well as the design of irrigation canal structures.
- To explain the principles and practices involved in reservoir planning, dam design (including gravity and earth dams), and the design of diversion headworks, ogee spillways, and energy dissipaters

Course Outcomes

Upon successful completion of the course, the students will be able to

- evaluating soil-water-plant relationships, determining crop water requirements, and selecting appropriate irrigation methods to optimize water use efficiency
- design irrigation canals
- design irrigation canal structures
- plan and design diversion head works
- select a suitable location for a dam, analyze stability of gravity and earth dams and design hydraulic ogee spillways

Course Content

UNIT – I:

Irrigation: Necessity and importance, principal crops and crop seasons, types, methods of application, soil-water-plant relationship, soil moisture constants, consumptive use, estimation of consumptive use, crop water requirement, duty and delta, factors affecting duty, depth and frequency of irrigation, irrigation efficiencies, water logging and drainage, standards of quality for irrigation water, crop rotation.

UNIT – II:

Canals: Classification, design of non-erodible canals - methods of economic section and maximum permissible velocity, economics of canal lining, design of erodible canals -Kennedy's silt theory and Lacey's regime theory, balancing depth of cutting.

UNIT – III:

Canal Structures:

Falls: Types and location, design principles of Sarda type fall and straight glacis fall. (Description only)

Regulators: Head and cross regulators, design principles (Description only)

Cross Drainage Works: Types, selection, design principles of aqueduct, siphon aqueduct and super passage. (Description only)

Outlets: Types, proportionality, sensitivity and flexibility

River Training: Objectives and approaches

UNIT – IV:

Diversion Head Works: Types of diversion head works, weirs and barrages, layout of diversion head works, components. causes and failures of weirs on permeable foundations, Bligh's creep theory, Khosla's theory, design of impervious floors for subsurface flow, exit gradient.

UNIT – V:

Reservoir Planning: Investigations, site selection, zones of storage, yield and storage capacity of reservoir, reservoir sedimentation.

Dams: Types of dams, selection of type of dam, selection of site for a dam.

Gravity dams: Forces acting on a gravity dam, causes of failure of a gravity dam, elementary profile and practical profile of a gravity dam, limiting height of a dam, stability analysis.

Earth Dams: Types, causes of failure, criteria for safe design, seepage, measures for control of seepage-filters.

Spillways: Types, design principles of Ogee spillways, types of spillways crest gates.

Text Books:

1. 'Irrigation and Waterpower Engineering' by Punmia B C, P.B.B Lal, A.K. Jain and A.K. Jain (2009), Laxmi Publications Pvt. Ltd., New Delhi
2. 'Irrigation and Water Resources Engineering' by Asawa G L (2013), New Age International Publishers.

Reference Books:

1. 'Irrigation Water Resources and Waterpower Engineering' by Modi P N (2011), Standard Book House, New Delhi
2. 'Irrigation Engineering' by Sharma R.K. and Sharma, T. K (2012), S. Chand & Co Publishers.
3. 'Water Resources Engineering' by Satyanarayana Murthy Challa (2008), New Age International Publishers.

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Professional Elective – II

ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

III Year – II Semester

Lecture : 3	Internal Marks : 30
Credits : 3	External Marks : 70

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Course Objectives

- To impart the basic concepts of artificial intelligence and machine learning the principles of knowledge representation and reasoning.
- To familiarize with neural networks and genetic algorithms.

Course Outcomes

Upon successful completion of the course, the students will be able to

- explain the basic concepts of artificial intelligence and knowledge representation.
- apply the principles of supervised learning methods.
- apply the principles of unsupervised learning methods and Bayesian learning.
- demonstrate neural networks and deep learning models.
- describe the ensemble methods and genetic algorithms.

Course Content

UNIT – I:

Introduction: Definition of Artificial Intelligence, Evolution, Need, and applications in real world. Intelligent Agents, Agents and Environments,Search Algorithms – Best first search, A-star algorithm.

Knowledge–Representation and Reasoning: Logical Agents: Knowledge-based agents, the Wumpus world, logic. Patterns in Propositional Logic, Inference in First-Order Logic-Propositional vs first order inference, unification.

UNIT – II:

Introduction to Machine Learning (ML): Definition, Evolution, Need, applications of ML in industry and real-world, types of machine learning, performance metrics - regression and classification problems, bias, variance, overfitting and under fitting.

Supervised Learning: Linear regression, logistic regression,Nearest-Neighbours, Decision Trees, Support Vector Machines.

UNIT – III:

Unsupervised Learning: Distance measurements,Clustering -K-Means, K-Medoids, DB Scan, Hierarchical learning.

Bayesian Learning: Bayes theorem, Concepts Learning, Naïve Bayes Classifier.

UNIT – IV:

Neural Networks: Biological neuron**,** Neural network representation, Perceptron, multilayer networks and backpropagation, Convolutional neural networks – architecture and applications, Recurrent Neural Networks – architecture and applications.

De**ep Learning:** Deep generative models, Boltzmann Machines, Auto-encoders, and Applications of Deep Networks – image processing, NLP and speech recognition.

UNIT – V:

Machine Learning Algorithm Analytics: Model Selection, Ensemble Methods - Boosting, Bagging, and Random Forests.

Genetic Algorithms: Local vs Global optima, Genetic algorithms- binary coded GA, operators, convergence criteria.

Text Books:

1. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, 2/e, Pearson Education, 2010.
2. S. Sridhar, M. Vijayalakshmi, Machine Learning, 3/e, 2024, Oxford University Press.

Reference Books:

1. Elaine Rich, Kevin Knight and Shivashankar B. Nair, Artificial Intelligence, 3/e, McGraw Hill Education, 2008.
2. Tom M. Mitchell, Machine Learning, McGraw Hill, 2013.
3. Amit Kumar Das, Saptarsi Goswami, Pabitra Mitra, Amlan Chakrabarti, Deep Learning, 4/e, Pearson India Education Services Pvt, Ltd., 2021.

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Professional Elective – III

AIR POLLUTION AND CONTROL

III Year – II Semester

Lecture : 3	Internal Marks : 30
Credits : 3	External Marks : 70

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Course Objectives

- To study the sources and classification of air pollution, and understand the fundamentals of meteorology and atmospheric stability.
- To learn about different types of air pollutants and their control techniques.
- To understand air pollution legislations, regulations, and their practical implications.

Course Outcomes

Upon successful completion of the course, the students will be able to

- identify various sources and types of air pollutants.
- analyze the influence of meteorological parameters on air quality.
- select appropriate techniques for the removal of particulate pollutants.
- select appropriate techniques for the removal of gaseous pollutants.
- understand and interpret air pollution legislation and regulatory frameworks

Course Content

UNIT – I: Sources and Classification of Air Pollution

Definitions; Significance; Types of pollutants; Sources and impacts on plants, animals, materials; Classifications - natural and artificial, primary and secondary, point and non-point, linear and areal sources, stationary and mobile; Ambient air quality standards by World Health Organization (WHO) and Central Pollution Control Board (CPCB).

UNIT – II: Air Pollution Meteorology

Composition and structure of the atmosphere; Atmospheric dispersion- Pressure, Wind, Moisture; Meteorological factors influencing air - heat, pressure, wind forces, moisture and relative humidity; Lapse rates – Environmental Lapse rate, Adiabatic Lapse rate; Influence of terrain and meteorological phenomenon on plume behavior and air quality; Wind rose diagrams.

UNIT – III: Particulate Matter and Control

Sources; Emission factors; Control techniques - control at sources, process changes, equipment modifications; Control Equipment - Working Principles and Operation - Settling chambers, Cyclone separators, Fabric filters, Scrubbers, Electrostatic precipitators.

UNIT – IV: Gaseous Pollutants and Control

Control of gaseous pollutants – Modification of operating conditions, modification of design conditions; Effluent gas treatment methods – Combustion- Direct flame combustion, Thermal Combustion, Catalytic Combustion;Absorption – Spray towers, Packed towers; Adsorption – Types of adsorbents, Multiple Fixed bed adsorber, Fluidized adsorber bed, Condensation – Surface Condenser, Contact Condenser; Air-fuel Ratio.

UNIT – V: Air Pollution Legislation and Regulations

The Air (Prevention and Control of Pollution)Act, 1981 - Constitution of the Board, Functions of Central and State Board, Emission Standards, Penal Provisions of the Act; Case studies – Bhopal gas Tragedy, London Smog, and Present Scenario of Delhi.

Text Books:

1. Air Pollution by M.N. Rao and H.V.N. Rao, 1st Edition, McGraw Hill Education.
2. Air Pollution and Control by K.V.S.G. Murali Krishna, 1st Edition, University Science Press, Laxmi Publisher.

Reference Books:

1. Environmental Engineering by Peavy, H.S, Rowe, D.R., and G. Tchobanoglous, McGraw Hill Inc., New York, 2017.
2. Sewage Disposal andAir Pollution Engineering, Environmental Engineering Vol. II by S.K. Garg,Khanna Publishers.
3. Noel de Nevers, Air Pollution Control Engineering" Publisher: McGraw Hill International Editions, 3rd Edition, 2016.

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Professional Elective – III

PROJECT ECONOMICS AND FINANCIAL ANALYSIS

III Year – II Semester

Lecture : 3	Internal Marks : 30
Credits : 3	External Marks : 70

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Course Objectives

- To understand basic economic concepts, including GDP, inflation, interest rates, and the role of the construction sector, alongside financial metrics like NPV, IRR, and the time value of money.
- To apply advanced financial techniques such as discounted payback period, sensitivity analysis, and breakeven analysis for evaluating projects.
- To develop skills in financial accounting, statement analysis, and gain an understanding of the Indian taxation system, along with financial markets, instruments, and the role of regulatory bodies like SEBI, IRDA, and RBI.

Course Outcomes

Upon successful completion of the course, the students will be able to

- demonstrate understanding of basic economics, including macroeconomic and microeconomic concepts.
- evaluate projects using key financial metrics like NPV, IRR, and cash flow analysis.
- apply advanced financial analysis tools like sensitivity analysis and cost-volume-profit analysis.
- prepare and interpret financial statements and apply Indian taxation concepts in business.
- analyze financial instruments and markets and understand the role of financial regulatory bodies.

Course Content

UNIT – I: Fundamentals of Economics

Introduction to economics; Macroeconomics - Basic terminologies; Indian economic status; GDP and its calculations; Microeconomics - Demand and Supply curve; Relationship between GDP, Inflation, Interest rate, and Employment; Importance and economics of construction sector; Different forms of construction business organization.

UNIT – II: **Financial Analysis and Project Evaluation**

Project selection criteria; Feasibility study; Cost of capital, Rate of return and Minimum attractive rate of return; Simple interest vs compound interest; cash flow diagram; Time value of money - Present value and future value of single amount, Present value and future value of Annuity, Annuities due, Loan amortization schedule; out of pocket commitment; payback period; Average annual rate of return; Net Present Value (NPV) -Alternatives with equal lives and unequal lives - Common multiple method, Study period method, Alternatives with infinite lives

UNIT – III: Advanced Financial Analysis Techniques

Discounted payback period; Internal rate of return; Future worth comparison; Equivalent annual charge; Benefit cost ratio; Incremental rate of return; Sensitivity analysis; Sensitivity analysis with single alternative, more than one alternative; Breakeven point; Marginal costing; Cost volume profit analysis; Margin of safety; Running account bills, Final account bills

UNIT – IV: Financial Accounting and Taxation

Financial accounting; Accounting process; Accounting concepts; Relevant accounting statements - Profit and loss statement, Balance sheet, Cash flow statement; Financial statement analysis; Case study of financial statement analysis; Ratio analysis. Indian taxation system; Introduction to tax planning; Overview of income tax and practice; Tax planning; Tax incentives and tax exemptions; Depreciation, effect of depreciation on tax calculation.

UNIT – V: Financial Markets and Instruments

Indian Monetary system and financial system - structure and role, Financial markets; Financial instruments – Equities, Bonds, Treasury Securities, Derivatives, Mutual Funds, Exchange-Traded Funds (ETFs); Basics of share market; Financial services – insurance, assets management companies, Credit rating agencies; Private equities - Leveraged Buyouts (LBOs) and venture capital, Financial regulatory bodies role and functions - Securities exchange board of India (SEBI), Insurance regulatory and development authority (IRDA), Reserve bank of India (RBI)

Text Books:

1. N. Gregory Mankiw, Principles of Economics, Cengage Learning, 2017.
2. Eugene F. Brigham and Michael C. Ehrhardt, Financial Management: Theory and Practice, Cengage Learning, 2016.

Reference Books:

1. Frank K. Reilly and Keith C. Brown, Investment Analysis and Portfolio Management, Cengage Learning, 2018.
2. H.R. Machiraju, Indian Financial System, Wiley Eastern, 2008.
3. Richard A. Brealey and Stewart C. Myers, Principles of Corporate Finance, McGraw-Hill Education, 2019.
4. Danny Myers, Construction Economics: A New Approach, Routledge, 2017.
5. Robert Libby, Patricia Libby, and Frank Hodge, Financial Accounting, McGraw-Hill Education, 2019.
6. Frederic S. Mishkin and Stanley G. Eakins, Financial Markets and Institutions, Pearson, 2018.

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Professional Elective – III

RAILWAYS, AIRPORTS AND HARBOUR ENGINEERING

III Year – II Semester

Lecture : 3	Internal Marks : 30
Credits : 3	External Marks : 70

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Course Objectives

- To introduce the principles and components of railway engineering, along with the functions and design principles of railway track geometry.
- To familiarize with the components of airports, including basic runway length, and the classifications, requirements, and components of harbors and docks.

Course Outcomes

Upon successful completion of the course, the students will be able to

- understand the components and their functions of a railway track.
- design geometrics in a railway track.
- apply knowledge of visual aids and airport zoning regulations in airport planning.
- plan and design airport layouts, runways, taxiways and terminals.
- understand classification and functional requirement of Ports, Docks and Harbours.

Course Content

UNIT – I: Components of Railway Engineering

Introduction and importance of railways in transportation , Railway gauges, Components of Permanent way: Rails, Sleepers, Ballast, Subgrade, Functions and requirements of each component, Rail joints, welding of rails, rail fixtures and fastenings, Creep of rails-Theories related to creep.

UNIT – II: Geometric Design of Railway Track

Alignment, horizontal curves, super elevation, equilibrium cant and cant deficiency, Length of transition curves, Gradients and grade compensation.

UNIT – III: Airport Planning & Design

Airport Master plan, Airport site selection, Aircraft characteristics, Zoning laws,Airport classification, Visual aids and Air traffic control.

UNIT – IV: Runway Design

Runway orientation – Wind rose diagram – Basic Runway length and corrections,
Geometric elements design, Taxiway design, Main and exit taxiway, Separation clearance, Holding aprons, Typical airport layouts, Terminal building, gate position.

UNIT – V: Harbours & Ports

Classifications of Harbours, Classification of ports – Requirement of a good port, facilities at a major Ports, Dry & wet docks, Quays, Wharves, Jetties, Breakwaters, Dredging, Navigational aids.

Text Books:

1. Railway Engineering by Saxena and S. P. Arora, Dhanpat Rai, Revised edition 2010.
2. Airport Engineering by S. K. Khanna, M. G Arora & S. S. Jain, Nemchand Bros, 6th edition 2012.
3. Docks and Harbour Engineering by S. P. Bindra, Dhanpathi Rai & Sons, 2012 edition.

Reference Books:

1. Principles of Railway Engineering by S. C. Rangwala, Charotar Publishing House, Anand.
2. Highway, Railway, Airport and Harbour Engineering by K. P. Subramanian, Scitech Publications (India) Pvt. Limited, 2010 Edition.
3. Air Transportation Planning and Design by V.Kumar and S. Chandra, Galgotia Publications Pvt. Ltd, 1999.
4. Harbour, Docks and Tunnel Engineering by R.Srinivasan.

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Professional Elective – III

DISASTER PREPAREDNESS, PLANNING AND MANAGEMENT

III Year – II Semester

Lecture : 3	Internal Marks : 30
Credits : 3	External Marks : 70

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Course Objectives

- To provide an exposure to disasters, their significance and types.
- To impart the knowledge on different approaches of disaster preparedness.

Course Outcomes

Upon successful completion of the course, the students will be able to

- analyse the concepts, terminologies and developments in the field of disaster and disaster management.
- differentiate the types of disasters, causes and their impact on environment and society.
- explain the process of risk and vulnerability.
- assess different types of disaster preparedness.
- explain the role of technology in disaster management.

Course Content

UNIT – I: Disaster and Disaster Management

Introduction, Disaster, Hazard – Classification of hazard, Magnitude of disasters, Vulnerability – Categorization of vulnerabilities, Coping Capacity, Risk – Disaster risk management, Risk formula, Disaster Management – Monitoring and evaluation, Disaster management cycle.

UNIT – II: Disasters Classification

Introduction, Types of disasters, Natural disasters - Earthquakes, Cyclones, Flood, Drought, Landslides, Avalanches, Manmade disasters – Chemical disaster, Industrial wastes, Hazardous wastes, Radioactivity, Traffic disasters.

UNIT – III: Risk and Vulnerability

Building codes and land use planning, social vulnerability, Macroeconomic management and sustainable development, environmental vulnerability, climate change risk rendition, financial management of disaster related losses.

UNIT – IV: Disaster Preparedness

Introduction, Components of preparedness, Formulation of preparedness plan, Types of disaster preparedness, Principles of preparedness, Problems associated with preparedness.

UNIT – V: Role of Technology in Disaster Management

Disaster management for infra structures, Mitigation program for earthquakes, Geospatial information in agricultural drought assessment, Multimedia technology in disaster risk management training, Transformable indigenous knowledge in disaster reduction.

Text Books:

1. Disaster Management – Global Challenges and Local Solutions, by Rajib shah & R R Krishnamurthy, Universities press, 2009.
2. Disaster Management, M.M. Sulphey, PHI Learning Pvt. Ltd, 2016.

Reference Books:

1. Disaster Science & Management by Tushar Bhattacharya, Tata McGraw Hill Education Pvt. Ltd., New Delhi.
2. An Introduction of Disaster Management- Natural Disasters & Vulnerable Hazard by S. Vaidyanathan, CBS Publishers& Distributors Pvt. Ltd.
3. Disaster Management - Future Challenges and Opportunities by Jagbir Singh I K International Publishing House Pvt. Ltd, 2007.

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Open Elective – II

DISASTER MANAGEMENT

III Year – II Semester

Lecture : 3	Internal Marks : 30
Credits : 3	External Marks : 70

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Course Objectives

- To develop a comprehensive understanding of disaster management, covering both natural and man-made hazards, and the chronological phases of disaster response and recovery.
- To introduce planning strategies, risk assessment, regulatory frameworks, and technological tools essential for effective disaster mitigation and management.
- To foster awareness of community-based disaster preparedness, education, and the role of various sectors in resilience building.

Course Outcomes

Upon successful completion of the course, the students will be able to

- analyze the disaster management cycle and apply case study methods to assess natural hazard impacts and mitigation strategies.
- evaluate causes and management approaches for various man-made disasters using real-world case studies.
- assess risk and vulnerability through planning tools such as building codes, land use strategies, and financial mechanisms.
- demonstrate the application of technologies like GIS, remote sensing, and multimedia in disaster monitoring, assessment, and training.
- develop community-based disaster preparedness plans by integrating education, social capital, and multi-sectoral collaboration.

Course Content

UNIT – I: Natural Hazards and Disaster Management

Introduction of DM – Inter disciplinary nature of the subject– Disaster Management cycle – Five priorities for action. Case study methods of the following: Vegetal Cover floods, droughts – Earthquakes – landslides – global warming, cyclones & Tsunamis – Post Tsunami hazards along the Indian coast.

UNIT – II: Man Made Disaster and Their Management Along With Case Study Methods of the Following

Fire hazards – transport hazard dynamics – solid waste management – post disaster – bio terrorism -threat in mega cities, rail and aircraft accidents, ground water, industries - Emerging infectious diseases and Aids and their management.

UNIT – III: Risk and Vulnerability

Building codes and land use planning – Social Vulnerability – Environmental vulnerability – Macro-economic management and sustainable development, Climate change risk rendition – Financial management of disaster – related losses.

UNIT – IV: Role of Technology in Disaster Managements

Disaster management for infra structures, taxonomy of infra structure – treatment plants and process facilities-electrical substations- roads and bridges- mitigation programme for earth quakes – flowchart, geospatial information in agriculture drought assessment - Multimedia

Technology in disaster risk management and training - Transformable Indigenous Knowledge in disaster reduction – Role of RS & GIS.

UNIT – V: Multi-sectional Issues, Education and Community Preparedness

Impact of disaster on poverty and deprivation - Climate change adaptation and human health - Exposure, health hazards and environmental risk-Forest management and disaster risk reduction -The Red cross and red crescent movement - Corporate sector and disaster risk reduction- Education in disaster risk reduction- Essentials of school disaster education - Community capacity and disaster resilience-Community based disaster recovery - Community based disaster management and social capital-Designing resilience- building community capacity for action.

Text Books:

1. An Introduction of Disaster Management- Natural Disasters & Vulnerable Hazards– S.Vaidyanathan: CBS Punblishers & Distributors Pvt.Ltd.
2. Natural Hazards & Disaster Management, Vulnerability and Mitigation by RB Singh-Rawat Publications

Reference Books:

1. 'Disaster Management' edited by H K Gupta (2003), Universities press.
2. 'Disaster Management – Global Challenges and Local Solutions' by Rajib shah & R R Krishnamurthy (2009), Universities press.R. Nishith, Singh AK,
3. "Disaster Management in India: Perspectives, Issues and strategies" New Royal Book Company."
4. 'Disaster Science & Management' by Tushar Bhattacharya, Tata McGraw Hill Education Pvt. Ltd., NewDelhi.
5. 'Disaster Management – Future Challenges and Opportunities' by Jagbir Singh (2007), I K International Publishing House Pvt.Ltd.

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Open Elective – II

SUSTAINABILITY IN ENGINEERING PRACTICES

III Year – II Semester

Lecture : 3	Internal Marks : 30
Credits : 3	External Marks : 70

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Course Objectives

- To introduce the foundational principles and models of sustainable development, environmental laws, and explore environmental issues at both local and global scales.
- To familiarize students with sustainability tools like EMS, LCA, EIA, and environmental auditing, and evaluate waste management practices.
- To study the integration of sustainability in construction, city planning, and industrial processes, along with the role of renewable energy sources and green technologies for sustainable growth.

Course Outcomes

Upon successful completion of the course, the students will be able to

- understand sustainability models, ethics, and key environmental legislations relevant to India.
- analyze the causes and effects of environmental degradation and apply zero waste concepts.
- gain practical insight into assessing and minimizing environmental impacts through systematic tools.
- propose sustainable solutions in building design and industrial ecosystems.
- evaluating various green energy systems and promoting sustainable business models.

Course Content

UNIT – I:

Introduction to Sustainable Engineering- Sustainable development, concepts of sustainable development: three pillar model, egg of sustainability model, Atkisson's pyramid model, prism model, principles of sustainable development, sustainable engineering, threats for sustainability.

Environmental Ethics and Legislations – Environmental ethics and education, multilateral environmental agreements and protocols, enforcement of environmental laws in India – The Water Act, The Air Act, The Environment Act.

UNIT – II:

Local Environmental Issues- Solid waste, impact of solid waste on natural resources, zero waste concept and 3R concept, waste to energy technology: thermo-chemical conversion, biochemical conversion

Global Environmental Issues- Resource degradation: deterioration of water resources, land degradation, air pollution, climate change and global warming, ozone layer depletion, carbon footprint, carbon trading.

UNIT – III:

Tools for Sustainability - Environmental management System (EMS), concept of ISO14000, life cycle assessment (LCA): basic components, advantages, disadvantages, case study, Environmental impact assessment (EIA), environmental auditing, bio mimicking, and case studies.

UNIT – IV:

Sustainable Habitat - Concept of green building, green building materials, green building certification and rating: green rating for integrated habitat assessment(GRIHA),leadership in energy and environmental design (LEED) rating, energy efficient buildings, sustainable cities, sustainable transport, sustainable pavements, case studies in sustainability engineering: Green building, sustainable city, sustainable transport system.

Sustainable Industrialization and Urbanization – Sustainable urbanization, industrialization, material selection, pollution prevention, industrial ecology, industrial symbiosis, poverty reduction.

UNIT – V:

Renewable energy resources- Conventional and non- conventional forms of energy, solar energy, fuel cells, wind energy, small hydro-plants, biogas systems, biofuels, energy from ocean, geothermal energy, conservation of energy**.**

Green technology and Green Business: Sustainable business, green technology, green energy, green construction, green transportation, green chemistry, green computing

Text Books:

1. R. Rajagopalan – Environmental Studies: From Crisis to Cure, Oxford University Press, 4th edition, 2023.
2. Suresh K. Dhameja – Sustainable Development and Environment, S. K. Kataria & Sons, 2nd Edition, 2015.

Reference Books:

1. Bradley Guy & Nicholas C. Gallaher – Sustainable Construction: Green Building Design and Delivery, Wiley, 5th Edition, 2022
2. Daniel T. Rogers, Barry L. John**son** – Environmental Science: Earth as a Living Planet, Wiley, 10th Edition,2022
3. Richard Heinberg – The End of Growth: Adapting to Our New Economic Reality, New Society Publishers, ist Edition, 2011.
4. Anubha Kaushik & C. P. Kaushik – Perspectives in Environmental Studies, New Age International Publishers, 8th Edition, 2022.

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ENVIRONMENTAL ENGINEERING LAB

III Year – II Semester

Lecture : 3	Internal Marks : 30
Credits : 1.5	External Marks : 70

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Course Objectives

- To determine key physical and chemical parameters of water and soil, such as pH, electrical conductivity, hardness, and evaluate buffering capacity and salinity hazards through acidity, alkalinity, and chloride determination.
- To quantify organic and inorganic solid content in wastewater and assess oxygen demand parameters like DO, BOD, and COD for water pollution monitoring.
- To determine the optimum dose of coagulant and chlorine required for effective water treatment, and understand their application in treatment design.

Course Outcomes

Upon successful completion of the course, the students will be able to

- understand basic water/soil quality indicators and their suitability for various uses.
- assess the impact of acidic/basic conditions and salt concentrations on the environment.
- interpret solid load data and recommend suitable treatment methods
- enables evaluation of water pollution levels and biodegradability of waste.
- gain hands-on skills in chemical dosing for turbidity removal and disinfection.

List of Experiments:

1. Determination of pH and Electrical Conductivity (Salinity) of Water and Soil.
2. Determination and estimation of Total Hardness–Calcium & Magnesium.
3. Determination of Alkalinity/Acidity
4. Determination of Chlorides in water and soil
5. Determination and Estimation of Total Solids, Organic Solids and Inorganic Solids and Settleable Solids by Imhoff Cone.
6. Determination of Iron.
7. Determination of Dissolved Oxygen with D.O. Meter & Wrinklers Method and B.O.D
8. Determination of C.O.D.
9. Determination of Optimum coagulant dose.
10. Determination of Chlorine demand.

Text Books:

1. R. C. Gaur - Laboratory Manual for Environmental Engineering, New Age International, New Delhi, st Edition, 2008
2. Dr. S.K. Panigrahi & L. Mohanty , Environmental Engineering Laboratory Manual, S.K. Kataria & Sons, 1st Ed 2023, reprinted 2024
3. S. S. Dara - A Textbook of Environmental Chemistry and Pollution Control (Lab-oriented), *S.* Chand Publishing, 7th Edition, 2017
4. Standard Methods for the Examination of Water and Wastewater, Washington DC: American Public Health Association (APHA) , 24th edition, 2023

HIGHWAY ENGINEERING LAB

III Year – II Semester

Lecture : 3	Internal Marks : 30
Credits : 1.5	External Marks : 70

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Course Objectives

- To test the properties of road aggregates, including crushing value, impact resistance, specific gravity, water absorption, attrition value, abrasion value, flakiness index, and elongation index.
- To evaluate the properties of bitumen, including penetration value, ductility value, softening point, flash and fire point, viscosity, and stripping, and to test the stability of the given bituminous mix. Additionally, to carry out surveys for traffic volume, speed, and parking.

Course Outcomes

Upon successful completion of the course, the students will be able to

- conduct standardized laboratory tests on road aggregates to evaluate their strength, durability, shape, and moisture susceptibility for pavement suitability.
- perform characterization of bituminous binders by measuring consistency, temperature susceptibility, adhesion, and safety parameters to determine their fitness for pavement applications.
- design and analyze bituminous mixes using Marshall Method to determine optimum bitumen content ensuring strength and stability of flexible pavements.
- execute and interpret traffic surveys including volume, speed, and parking studies to derive key parameters for traffic flow analysis and infrastructure planning.
- apply principles of highway geometric design to compute earthwork quantities and develop technically accurate drawings of road cross sections and intersection layouts.

Course Content

List of Experiments

I. Road Aggregates:

1. Aggregate Crushing value Test
2. Aggregate Impact Test.
3. Specific Gravity and Water Absorption Test
4. Attrition Test
5. Abrasion Test.
6. Shape tests

II. Bituminous Materials:

1. Penetration Test.
2. Ductility Test.
3. Softening Point Test.
4. Flash and fire point tests.
5. Stripping Test
6. Viscosity Test.

III. Bituminous Mix:

1. Marshall Stability test.

IV. Traffic Surveys:

1. Traffic volume study at mid blocks.
2. Traffic Volume Studies (Turning Movements) at intersection.
3. Spot speed studies.
4. Parking study.

V. Design & Drawing

1. Earthwork calculations for road works
2. Drawing of road cross sections
3. Rotary intersection design

Perform any TEN experiments covering all areas

Text Books:

1. 'Highway Material Testing Manual' by S.K. Khanna, C.E.G Justo and A.Veeraraghavan, Neam Chan Brothers New Chand Publications, New Delhi.

Reference Books:

1. IRC Codes of Practice
2. Asphalt Institute of America Manuals
3. Code of Practice of B.I.S.

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SOFT SKILLS

III Year – II Semester

Practical : 2 Tutorial : 1	Internal Marks : 30
Credits : 2	External Marks : 70

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Course Objectives

- To prepare to face global competition for employment and excellence in profession.
- To help the students understand and build interpersonal skills that will enable them to lead meaningful professional life.

Course Outcomes

Upon successful completion of the course, the students will be able to

- assimilate and understood the meaning and importance of soft skills and learn how to develop them.
- understand the significance of soft skills in the working environment for professional excellence.
- prepare to undergo the placement process with confidence and clarity.
- ready to face any situation in life and equip themselves to handle them effectively.
- understand and learn the importance of etiquette in both professional and personal life.

Course Content

UNIT – I: Introduction

Introduction- Emergence of life skills, Definition & Meaning, Importance & need, reasons for skill gap, Analysis--Soft Skills vs. Hard skills, Linkage between industry and soft skills, Challenges, Personality Developments. Soft Skills, Soft Skills vs. English, Improving Techniques.

UNIT – II: Intra-Personal

Definition-Meaning – Importance-SWOT analysis, Johari windows - Goal Setting- quotient skills - Emotional Intelligence- Attitudinal skills - Right thinking- Problem Solving-Time management, stress management.

UNIT – III: Inter-Personal

Definition–Meaning–Importance-Communications skills-Team Work, managerial skills - Negotiation skills - Leadership skills, corporate etiquettes.

UNIT – IV: Verbal Skills

Definition and Meaning - Listening skills, need-types, advantages, Importance -Improving Tips for Listening, Speaking, need-types, advantages, Importance - Improving Tips, Reading - Writing Skills, Report, Resume, statement of purpose, need- types, advantages, Importance - Improving Tips.

UNIT – V: Non-Verbal Skills & Interview Skills

Definition and Meaning – Importance - Facial Expressions - Eye Contact - Proxemics – Haptics - Posture, cross cultural body language, body language in interview room, appearance and dress code - Kinetics - Para Language - tone, pitch, pause, neutralization of accent, use of appropriate language, Interview skills, interview methods and questions.

Text Books:

1. Sherfield, M. Robert et. al, "Cornerstone Developing Soft Skills", 4th Edition, Pearson Publication, 2014.

2. Alka Wadkar, “Life Skills for Success”, 1st Edition, Sage Publications India Private Limited, 2016.

Reference Books:

1. M. Sambaiah, “Technical English”, Wiley Publishers India, New Delhi. 2014.
2. Gangadhar Joshi, “From Campus to Corporate”, Sage Texts, 1stEdition.
3. K. Alex, “Soft Skills”, S. Chand Publication, 3rd Edition, 2014.
4. Meenakshi Raman and Sangita Sharma, “Technical Communication: Principle and
5. Practice”, Oxford University Press, 2009.
6. Shalini Varma, “Body Language for Your Success Mantra”, S. Chand
7. Publication, 4th Edition, 2014.
8. Stephen Covey, “Seven Habits of Highly Effective People”, JMD Book, 2013.

e-Learning Resources:

1. https://onlinecourses.nptel.ac.in/noc20_hs60/preview
2. http://www.youtube.com/@softskillsdevelopment6210
3. https://youtube.com/playlist?list=PLLy_2iUCG87CQhELCytvXh0E_ybOO1_q&si=Fs05Xh8ZrOPsR8F4
4. https://www.coursera.org/learn/people-soft-skills-assessment?language=English
5. https://www.edx.org/learn/soft-skills

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TECHNICAL PAPER WRITING AND IPR

(Common to CE, ME, CSE, IT, CSE(AI&ML), AI&DS, IoT)

III Year – II Semester

Lecture : 2	Internal Marks : 30
Credits : -	External Marks : 70

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Course Objectives

- To equip students with advanced academic writing and publishing skills.
- To provide a thorough understanding of Intellectual Property Rights.X

Course Outcomes

Upon successful completion of the course, the students will be able to

- compose well-structured, concise, and unambiguous abstracts and introductions.
- critique and synthesize existing scholarly work to write a compelling Literature Review.
- explain the fundamental nature and distinction between different types of Intellectual Property.
- analyze the scope of Patent Rights and the procedures involved in licensing and technology transfer.
- evaluate the legal and administrative challenges posed by new developments in IPR.

Course Content

UNIT – I

Planning and Preparation: Planning and Preparation, Word Order, breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness. Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction.

UNIT – II

Literature Review: Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

Key skills needed when writing a Title, Abstract, Introduction, a Review of the Literature, the Methods, the Results, the Discussion, and the Conclusions. Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

UNIT – III

Process and Development: Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, patenting under PCT.

UNIT – IV

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology, Patent information and databases, Geographical Indications.

UNIT – V

New Developments In IPR: New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies.

Text Books:

1. Day, R. How to Write and Publish a Scientific Paper. Cambridge University Press, 2006.
2. Halbert. Resisting Intellectual Property. Taylor & Francis Ltd, 2007.

Reference Books:

1. Goldbort, R. Writing for Science. Yale University Press, 2006.
2. Highman, N. Handbook of Writing for the Mathematical Sciences. SIAM, 1998.
3. Wallwork, Adrian. English for Writing Research Papers. Springer New York Dordrecht Heidelberg London, 2011.
4. Mayall. Industrial Design. McGraw Hill, 1992.
5. Merges, Robert P., Peter S. Menell, and Mark A. Lemley. Intellectual Property in New Technological Age. Year Unknown, 2016. (The publisher is missing in the original source.)
6. Ramappa, T. Intellectual Property Rights Under WTO. S. Chand, 2008.

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Honors Degree

STRUCTURAL DYNAMICS

III Year – II Semester

Lecture : 3	Internal Marks : 30
Credits : 3	External Marks : 70

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Course Objectives

- To impart knowledge on degrees of freedom, dynamic loading and ability to formulate dynamic equation of motion and apply them to simple dynamic problems.
- To introduce the methodology for determining the natural frequencies and mode shapes for un-damped multi-degree freedom systems- Examples on applying up to two-degrees of freedom systems.
- To create experimental knowledge on spring-mass model, obtaining frequencies and mode shapes using shake table and demonstration of important earthquake tips.

Course Outcomes

Upon successful completion of the course, the students will be able to

- apply the concept of SHM to obtain natural frequency of SDOF using different methods.
- develop differential equation of motion for undamped single degree freedom systems and two degrees of freedom systems.
- obtain the response of single degree freedom systems to harmonic, impulse and dynamic loadings.
- determine natural frequencies and mode shapes of multi-degree freedom systems (up to two degrees of freedom systems) and verify orthogonality condition.
- gain experimental knowledge on developing mass-spring models, obtaining frequencies and mode shapes using shake table.

Course Content

UNIT – I: Theory of Vibrations

Elements of vibrating system- Degrees of freedom – Lumped Mass Idealization- Simple Harmonic Motion (SHM), Critical damping, Types of damping, Single Degree un-damped and damped vibrating systems – Logarithmic decrement.

UNIT – II: Introduction to Structural Dynamics

Types of dynamic loading- formulation of equation of motion by different methods- Direct equilibrium equation using Newton's law of motion, D' Alembert Principle and principle of virtual work- Examples.

UNIT – III: Undamped and Damped Single Degree Freedom System

Formation and solution for equation of un-damped SDOF system- Equivalent stiffness of spring combinations- Springs in parallel and series, Types of damping – Viscous damping, Coulomb damping and Logarithmic decrement -Examples.

UNIT – IV: Response to Harmonic and General Dynamic Loading

Response of SDOF System to Harmonic, Impulsive and General dynamic loading – Examples.

UNIT – V: Multi Degree Freedom System

Selection of degrees of freedom- Evaluation structural properties developing mass and stiffness matrices and formulation of Multi-Degrees of Freedom (MDOF) system- Equations of motion for un-damped MDOF systems- Solution of Eigen value problem to determine natural frequencies and mode shapes- Orthogonal properties of normal modes.

Text Books:

1. Structural Dynamics by Mario Paz and Leigh; CBS Publishers, 1st edition 1985.
2. Structural Dynamics and A seismic Design by S.R. Damodara swamy & S. Kavitha; PHI Learning private Ltd., New Delhi

Reference Books:

1. Dynamics of Structures by Anil K. Chopra, Pearson Education (Singapore), Delhi
2. Dynamics of Structures by Raymond W. Clough, Joseph Penzien; M.C. Graw Hill Book Company.
3. Dynamics of Structures by Clough & Penzien, McGraw Hill, New York.

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Honors Degree

STRUCTURAL DESIGN LAB

III Year – II Semester

Practical : 3	Internal Marks : 30
Credits : 1.5	External Marks : 70

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Course Objectives

- To enable students to understand and evaluate the dynamic characteristics of structures such as natural frequency, stiffness, and damping through experimental testing.
- To develop analytical and practical skills for assessing seismic behavior and structural performance under different vibration conditions.

Course Outcomes

Upon successful completion of the course, the students will be able to

- determine natural frequencies and time periods of structural elements and building models using vibration testing methods.
- evaluate seismic behavior of structures such as water tanks and soils, and propose suitable strengthening strategies for improved performance.

List of Experiments:

(Perform any 10 of the following experiments)

1. To determine the natural frequencies and time periods of a building from the free vibration tests.
2. To determine the natural frequencies and time periods of a building from the forced vibration tests.
3. To assess the importance of stiffness for a multi storied building.
4. To determine the natural frequencies and time periods of a simply supported beam
5. To determine the natural frequencies and time periods of a continuous beam.
6. To assess the seismic behaviour of a water tank
7. To assess the importance of liquefaction in seismic resistant studies
8. To compare the natural frequencies of water tank with bracing and without bracing.
9. To evaluate the damping ratio of a building model using free decay response.
10. To determine the mode shapes of a multi-storied frame using vibration measurement sensors.

Text Books:

1. Chopra, A. K. (2012). Dynamics of Structures: Theory and Applications to Earthquake Engineering. Pearson Education.
2. Clough, R. W., & Penzien, J. (2003). Dynamics of Structures. McGraw Hill.

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