

**Course Structure & Syllabus of
B. Tech. Programme in
Civil Engineering
Academic Year – 2019-20**



**VEER SURENDRA SAI UNIVERSITY OF
TECHNOLOGY, ODISHA
Burla, Sambalpur-768018, Odisha**

Vision

To emerge as an internationally acclaimed Civil Engineering Department for imparting futuristic technical education and creation of vibrant research enterprise to create quality civil engineers and researchers, truly world class leaders and unleash technological innovations to serve the global society and improve the quality of life.

Mission

The Department of Civil Engineering, VSSUT Burla strives to create values and ethics in its products by inculcating depth and intensity in its education standards and need based research through

- Participative learning in a cross-cultural environment that promotes the learning beyond the class room.
- Collaborative partnership with industries and academia within and outside the country in learning and research.
- Encouraging innovative research and consultancy through the active participation and involvement of all faculty members.
- Facilitating technology transfer, innovation and economic development to flow as natural results of research wherever appropriate.
- Expanding curricula to cater broader perspectives.
- Creation of service opportunities for upliftment of the society at large.

PO

- a. Ability to apply knowledge of mathematics, science and engineering to solve complex problems in civil engineering
- b. Ability to identify, formulate, and solve complex civil engineering problems using first principle of mathematics, basic science & engineering
- c. Ability to design, implement & evaluate civil engineering projects to meet societal and environmental needs
- d. Ability to design and conduct complex civil engineering experiments as well as to analyze and interpret the experimental data
- e. Ability to use the techniques, skills, and modern engineering tools necessary for relevant engineering practices
- f. Ability to assess impact of contemporary social issues on professional practice
- g. Ability to recognize the sustainability and environmental impact of the engineering solutions
- h. Ability to follow prescribed norms, responsibilities and ethics in engineering practices
- i. Ability to work effectively as an individual and in a team
- j. Ability to communicate effectively through oral, written and pictorial means with engineering community and the society at large.
- k. Ability to recognize the need for and to engage in life-long learning
- l. Ability to understand and apply engineering and management principles in executing projects.

PEO

- To lead a successful career in industries, pursue higher studies and entrepreneurial endeavors.
- To offer techno-commercially feasible and socially acceptable solutions to real life engineering problems.

- To demonstrate effective communication skill, professional attitude and a desire to learn.
- To have a reputation as a source of innovative solutions for challenging problems
- To be a trustworthy and respectful member in society

PSO

- Plan, analyse, design, prepare and execute all kinds of civil engineering projects
- Apply latest construction techniques for successful completion of time bound projects with optimised cost
- Follow modern management tools for innovative solutions

VEER SURENDRA SAI UNIVERSITY OF TECHNOLOGY, BURLA, ODISHA

PROPOSED COURSE STRUCTURE FOR BACHELOR OF TECHNOLOGY COURSES TO BE EFFECTIVE FROM JULY 2019- 2020

COURSE STRUCTURE FIRST YEAR		FIRST SEMESTER (THEORY)		
Sl. No	Course Code	Subject	Contact Hrs. L-T-P	Credits
1	BMA01001	Mathematics-I	3-1-0	4
2	BPH01001	Physics	3-0-0	3
3	BEE01001	Basic Electrical Engg.	3-0-0	3
4	BHU01001	English For Business Communication	3-0-0	3
5	BME01001	Engineering Mechanics	3-0-0	3
SESSIONALS				
1	BPH01002	Physics Laboratory	0-0-3	1.5
2	BEE01002	Basic Electrical Engg. Lab	0-0-3	1.5
3	BHU01002	Business Communication Skills	0-0-3	1.5
4	BME01002	Workshop & Manufacturing Practices	0-0-3	1.5
NON-CREDIT				
1	BNC01001	Induction Programme and participation in Clubs / Societies	0-0-0	0
Total			15-1-12	22

COURSE STRUCTURE FIRST YEAR		SECOND SEMESTER (THEORY)		
Sl. No.	Course Code	Subject	Contact Hrs. L-T-P	Credits
1	BMA02001	Mathematics - II	3-1-0	4
2	BCH02001	Chemistry	3-0-0	3
3	BEC02001	Basic Electronics	3-0-0	3
4	BIT02001	Programming for Problem Solving	3-0-0	3
5	BCE02001	Basic Civil Engg.	3-0-0	3
SESSIONALS				
1	BCH02002	Chemistry Lab	0-0-3	1.5
2	BEC02002	Basic Electronics Lab	0-0-3	1.5
3	BIT02002	Programming Lab /	0-0-3	1.5
4	BCE02002	Engineering Graphics & Design	0-0-3	1.5
NON-CREDIT				
1	BNC02001	NSS/NCC/Yoga	0-0-0	0
Total			15-1-12	22

COURSE STRUCTURE		THIRD SEMESTER		
SECOND YEAR		(THEORY)		
Sl. No	Course Code	Subject	Contact Hrs. L-T-P	Total Credits
1	BMA03001	Math-III	3-1-0	4
2	BCE03001	Mechanics of Material	3-0-0	3
3	BCE03002	Civil Engineering Materials and Construction	3-0-0	3
4	BCE03003	Environmental Science and Engineering	3-0-0	3
5	BHU03001	Organisational Behaviours	3-0-0	3
SESSIONAL				
1	BCE03004	Concrete Lab	0-0-3	1.5
2	BCE03005	Environmental Science Lab.	0-0-3	1.5
3	BCE03006	Environmental Engineering Design	0-0-3	1.5
4	BCE03007	Computer Application in Civil Engineering	0-0-3	1.5
NON-CREDIT				
1	BNC03001	Essence of India Traditional Knowledge/ Environmental Sciences	0-0-0	0
TOTAL			14-1-12	22

COURSE STRUCTURE		FOURTH SEMESTER		
SECOND YEAR		(THEORY)		
Sl. No	Course Code	Subject	Contact Hrs. L-T-P	Credit
1	BCE04001	Structural analysis –I	3-0-0	3
2	BCE04002	Surveying and Geomatics	3-1-0	4
3	BCE04003	Geotechnical Engineering-I	3-0-0	3
4	BCE04004	Fluid Mechanics	3-0-0	3
5	BHU04001	Economics for Engineers	3-0-0	3
SESSIONALS				
1	BCE04005	Survey Practice	0-0-3	1.5
2	BCE04006	Building Drawing	0-0-3	1.5
3	BCE04007	Geotechnical Engineering Lab	0-0-3	1.5
4	BCE04008	Fluid Mechanics Lab	0-0-3	1.5
NON-CREDIT				
1	BNC04001	Environmental Sciences/ Essence of India Traditional Knowledge	0-0-0	0
2	BNC04002	Summer Internship/ Training	0-0-0	0
Total			14-1-12	22

COURSE STRUCTURE THIRD YEAR		FIFTH SEMESTER (THEORY)		
SI. No	Course Code	Subject	Contact Hrs. L-T-P	Credit
1	BCE05001	Reinforced Concrete Design	3-0-0	3
2	BCE05002	Fluid Dynamics	3-0-0	3
3	BCE05003	Geotechnical Engineering-II	3-0-0	3
4		Professional Elective-I	3-0-0	3
5		Open Elective-I	3-0-0	3
6		Professional Ethics, Professional Law & Human Values / Financial Management, Costing, Accounting, Balance Sheet & Ratio Analysis	2-0-0	2
SESSIONAL				
1	BCE05004	Structural Engineering Lab.	0-0-3	1.5
2	BCE05005	Design of Concrete Structure	0-0-3	1.5
3	BCE05006	Fluid Flow Lab.	0-0-3	1.5
Total			17-0-9	21.5

COURSE STRUCTURE THIRD YEAR		SIXTH SEMESTER (THEORY)		
SI. No	Course Code	Subject	Contact Hrs. L-T-P	Credit
1	BCE06001	Transportation Engineering-I	3-0-0	3
2	BCE06002	Steel Structure	3-0-0	3
3		Professional Elective-II	3-0-0	3
4		Professional Elective-III	3-0-0	3
5		Open Elective-II	3-0-0	3
6		Financial Management Costing, Accounting, Balance Sheet & Ratio Analysis/ Professional Ethics, Professional Law & Human Values	2-0-0	2
SESSIONALS				
1	BCE06003	Design of Hydraulic Structure	0-0-3	1.5
2	BCE06004	Transportation Engineering Lab	0-0-3	1.5
3	BCE06005	Design of Steel Structure	0-0-3	1.5
NON-CREDIT				
1	BNC06001	Summer Industry Internship/ Training/ Project	0-0-0	0
Total			17-0-9	21.5

List of Professional Elective (3 rd Year)			
Sl. No.	Category	Course Code	Subject Name
1	UPE-I	BCEPE601	Advanced Surveying
2		BCEPE602	River Engineering
3		BCEPE603	Industrial Waste Water Treatment
1	UPE-II	BCEPE604	Advanced Concrete Design
2		BCEPE605	Open Channel Flow
3		BCEPE606	Mechanics of Composite Materials
4		BCEPE607	Rock mech and Tunnel Engg
5		BCEPE608	Water Resources Engineering
1	UPE-III	BCEPE609	Hydraulics Structure
2		BCEPE610	Water Resources Planning & Management
3		BCEPE611	Machine foundation
4		BCEPE612	Urban Drainage and sewerage system

List of Open Elective (3rd Year)

Sl. No.	Category	Course Code	Subject Name
1	UOE-I	BCEOE601	Remote Sensing and GIS
2		BCEOE602	Watershed Management
3		BCEOE603	Waste Management
1	UOE-II	BCEOE604	Project Management
2		BCEOE604	Town Planning & Architecture
3		BCEOE606	Ground Improvement Technique

**COURSE STRUCTURE SEVENTH SEMESTER
FOURTH YEAR (THEORY)**

SL NO	COURSE CODE	SUBJECT	CONTACT HRS L-T-P	CR
1	BCE07001	Structural Analysis-II	3-0-0	3
2	BCE07002	Transportation Engineering-II	3-0-0	3
4		Professional Elective-IV	3-0-0	3
5		Open Elective-III	3-0-0	3
SESSIONALS				
1		Project – I	0-0-6	3
2	BCE07003	Transportation & Geotechnical Engineering Design	0-0-3	1.5
3		Seminar on internship	0-0-3	1.5
TOTAL			12-0-12	18

COURSE STRUCTURE FOURTH YEAR		EIGHTH SEMESTER (THEORY)		
SL NO	COURSE CODE	SUBJECT	CONTACT HRS L-T-P	CR
1		Professional Elective-V	3-0-0	3
2		Professional Elective-VI	3-0-0	3
3		Open Elective-IV	3-0-0	3
SESSIONALS				
1		Project II	0-0-12	6
2		Seminar on Project	0-0-2	1
TOTAL			9-0-14	16

Note: Each hour of practical /lab/sessional class = 0.5 credit

The students should undergo Summer Internship or Project in India or Abroad for a minimum period of 8 weeks either in 4th & 6th Semesters together or in one semester at a stretch.

List of Professional Elective (4th Year)

Sl. No.	Category	Course Code	Subject Name
1	UPE-IV	BCEPE701	Estimation and Professional Practice
2		BCEPE702	Economic evaluation and analysis of transport project
3		BCEPE703	Computational Fluid Dynamics
4		BCEPE704	Structural Design of Water and Sewerage System
5		BCEPE705	Bridge Engineering
1	UPE-V	BCEPE801	Construction Management
2		BCEPE802	Soil Dynamics & Earthquake Engineering
3		BCEPE803	Pavement management system
4		BCEPE804	Advanced Solid Mechanics
5		BCEPE805	Traffic Engg. & Management
1	UPE-VI	BCEPE806	Advance Foundation Engineering
2		BCEPE807	Pavement Design
3		BCEPE808	Ground Water Engineering
4		BCEPE809	Concrete technology
5		BCEPE810	Environmental Geotechnique
6		BCEPE811	Prestressed Concrete

List of Open Elective (4th Year)

Sl. No.	Category	Course Code	Subject Name
1	UOE-III	BCEOE701	Green building
2		BCEOE702	Water Power Engg
1	UOE-IV	BCEOE801	Finite Element Method in Civil Engineering
2		BCEOE802	Environmental Management

DETAILS SYLLABI

IST SEMESTER

THEORY

Mathematics-I (Calculus and Linear Algebra)

Module 1: Calculus (8 Lectures)

Rolle's theorem, Mean value theorems (statements only) and applications. Introduction to improper integrals. Beta and Gamma functions and their properties.

Module 2: Calculus (8 Lectures)

Convergence of sequence and series, tests of convergence. Fourier series, arbitrary period, even and odd function, half range series.

Module 3: Calculus (8 Lectures)

Limit, continuity and partial derivatives (two variables), maxima and minima. Vector and scalar point functions and fields, gradient of a scalar field, directional derivative, divergence of a vector field, curl of a vector field and applications

Module 4: Linear Algebra (8 Lectures)

Linear systems of equations, Gauss elimination, linear independence, rank of a matrix, Gauss-Jordan elimination. Vector Space; basis and dimension'

Module 5: Linear Algebra (8 Lectures)

Eigen values, eigenvectors, some applications of eigenvalue problems, symmetric, skew-symmetric and orthogonal matrices, diagonalization, quadratic forms, complex matrices and forms.

Text Book:

- 1) Erwin Kreyszig, Advanced Engineering Mathematics (9th Edition), Wiley India Pvt. Ltd
- 2) S.C. Malik and S. Arora, Mathematical Analysis, New Age International

Reference Books:

- 1) George B. Thomas, Jr. and Ross L. Finney, Calculus and Analytic Geometry, Addison Wesley Publishing Company
- 2) B.V. Ramana, Higher Engineering Mathematics, McGraw Hill
- 3) A. Stroud, Advanced Engineering Mathematics, Industrial Press
- 4) S.K. Paikray, Text book of Matrix Algebra, Kalyani Publisher

COURSE OUTCOMES:

CO1: Explain basic knowledge of differential calculus and improper integral and have a basic understanding of Beta and Gamma functions useful in various fields

CO2: Develop a tool of Fourier series understanding the periodic phenomenon for learning advanced Engineering mathematics.

CO3: Summarize functions of several variables that is essential in most of the branches of engineering.

CO4: Apply Gauss elimination method and rank of a matrix in solving linear equations.

CO5: Practice the knowledge of eigenvalues and eigenvectors in a comprehensive manner.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	1	1							
CO2	2	2	1	1	1							
CO3	2	1			3							
CO4	3	2	1	2	1	2						
CO5	3	2	3	2	1	1	3	1	2	2	2	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	2	2	1	1	1	1	1	0	0	0	0	0

ENGINEERING PHYSICS

MODULE-I:

PROPERTIES OF MATTER: Idea of elastic constants (Y , K , η and σ), relation between elastic constants, torsion pendulum, determination of η , Cantilever at one end.

MODULE-II:

OSCILLATION AND WAVES: Review of Simple Harmonic Oscillation and application to compound pendulum, Damped harmonic oscillation, Forced oscillation, Resonance, (Amplitude resonance, Velocity resonance, Sharpness of resonance).

MODULE-III:

OPTICS: Concept of wave and wave equation, Superposition of many harmonic waves. Interference, Concept of coherent Sources (Division of wave front and division of amplitude) Interference in thin parallel film, Newton's ring (Theory, Application: Determination of wavelength of light, Refractive index of liquid). Concept of diffraction (Huygen's principle), types of diffraction, Fraunhofer diffraction due to single slit and diffraction grating. Determination of wavelength, Dispersive power and resolving power of plane diffraction grating, Polarisation: Double refraction, Half 'Wave plate and quarter wave plate.

MODULE-IV:

ELECTROMAGNETISM: Vector Calculus: Gradient, Divergence, Curl (Mathematical concept), Gauss divergence theorem and Stoke's theorem (statements only), Derivation of Maxwell's electromagnetic equation in differential form and in integral form, Electromagnetic wave equations for E and B in vacuum and conducting medium, transverse nature of EM waves.

MODULE-V:

QUANTUM PHYSICS & PHOTONICS: Wave particle duality, Matter waves (de Broglie Hypothesis), Wave functions, Observable as Operators, Eigen function and Eigen values, Normalization, Expectation values, Schrodinger equation (Time dependent and time independent), Particle in a box.

LASERS: Introduction, Characteristics of lasers, Einstein's coefficients & Relation between them, Lasing action (Population inversion, Three and Four level pumping schemes), Different types of Lasers (Ruby Laser, He-Ne Laser).

Text Books:

Principles of Engg. Physics; Md. N. Khan and S. Panigrahi

Reference Books:

Oscillation and waves: N. Subrahmanyam and BrijLal

Optics-A.K. Ghatak

Electrodynamics by: D. J. Griffith

Concepts of Modern Physics-A. Beiser

Lasers, Theory and Applications-K. Thyagarajan and A.K.Gha

COURSE OUTCOMES:

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO												

BASIC ELECTRICAL ENGINEERING

Syllabus:

MODULE-I (8 HOURS)

D.C circuit analysis and network theorems: Concept of network, Active and passive elements, voltage and current sources, concept of linearity and linear network, unilateral and bilateral elements, source transformation, Kirchoff's Law: loop and nodal methods of analysis, star delta transformation, network theorems: Thevenin's theorem, Norton's theorem, maximum power transfer theorem. Transients, in R-L, R-C and R-L-C circuits with DC Excitation.

MODULE-II (8 HOURS)

Single phase and three phase ac circuit: Sinusoidal, square and triangular waveforms-average and effective value, form the peak factors, concept of phasors, phasors representation of sinusoidally varying voltage and current, analysis of series-parallel RLC circuits. Apparent, active and reactive powers, power factor, power factor improvement, resonance in series and parallel circuits, bandwidth and quality factors, star and delta connections, balanced supply and balanced load, line and phase voltage/current relation, three phase power measurements.

MODULE-III (8 HOURS)

Magnet circuit & principle of electromechanical energy conversion: Analogy between electric and magnetic circuit, magnetic circuits with DC and AC excitation, magnetic leakage, BH curve, hysteresis and eddy current losses, magnetic circuit calculation, mutual coupling. Principles of dc motor & generator, types, emf equation of DC machine, torque equation of motor, Speed control of dc motor. characteristics and applications of DC motors.

MODULE-IV (8 HOURS)

AC MACHINES: Single Phase Transformer: Principle of operation, construction, emf equation, equivalent circuit, power losses, efficiency, Introduction to auto transformers. Three Phase Induction

English for Business Communication

Module 1: Fundamentals of Communication (6 Hours)

- ❖ Process of Communication, Types of Communication (Verbal & Non Verbal)
- ❖ Channels of Business Communication
- ❖ Barriers to Communication.
- ❖ Plain English
- ❖ Bias free language
- ❖ Cross Cultural Communication

Module 2: Communicative Grammar (06 Hours)

- ❖ Time and Tense
- ❖ Aspects (Perfective & Progressive)
- ❖ Verbs of State and Event
- ❖ Passive and Active Voice
- ❖ Conditionals

Module 3: Sounds of English (06 Hours)

- ❖ The Speech Mechanism and Organs of Speech
- ❖ Consonant Sounds of English
- ❖ Vowel Sounds of English
- ❖ Stress Pattern: Syllable, Stress and Intonation.
- ❖ Problem sounds for Indian Speakers

Module 4: Business Writing (06 Hours)

- ❖ Paragraph writing
- ❖ Sentence Linker
- ❖ Business Letters
- ❖ Report Writing
- ❖ Proposal writing

Module 5: Professional Writing (06 Hours)

- ❖ Notice, Circular and Memo writing
- ❖ Agenda & Minute writing
- ❖ Writing Cover letter
- ❖ Résumé (CV) Writing

Text Books:

1. Effective Technical Communication by M Ashraf Rizvi (Tata McGraw Hill)
2. Business Communication by Hory Sanker Mukerjee (Oxford University Press)
3. Better English Pronunciations By J. D.O Conner (Cambridge University Press)
4. A Communicative Grammar of English by G.N. Leech and Jan Svartik (OUP)

Reference Books: "Business communication" by Ramachandran, Lakshmi and Krishna (Macmillan)

COURSE OUTCOMES:

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO												

ENGINEERING MECHANICS

Course Contents:

Module - I (8 Hours)

Concurrent forces on a plane: Composition, resolution and equilibrium of concurrent coplanar forces, method of moment.

General case of forces on a plane: Composition and equilibrium of forces in a plane, plane trusses, method of joints and method of sections, plane frame, equilibrium of ideal systems.

Module-II (8 Hours)

Friction: Problems involving dry friction, Ladder, Wedges

Principle of virtual work.

Module - III (8 Hours)

Parallel forces on a plane: General case of parallel forces, center of parallel forces and center of gravity, centroid of composite plane figure and curves, Theorems of Pappus.

Moments of inertia: Plane figure with respect to an axis in its plane and perpendicular to the plane, Polar moment of inertia, parallel axis theorem

Module – IV (8 Hours)

Rectilinear translation: Kinematics, principle of dynamics, D'Alembert's Principle,

Principle of work and energy for a particle and a rigid body in plane motion, Conservation of energy, Principle of impulse and momentum for a particle and a rigid bodies in plane motion, Conservation of momentum, System of rigid bodies, Impact, direct and central impact, coefficient of restitution.

Module – V (8 Hours)

Curvilinear translation: Kinematics, equation of motion, projectile, D'Alembert's principle of curvilinear motion.

Kinematics of rotation of rigid body.

Text Book:

1. Engineering Mechanics: S Timoshenko & Young; 4th Edition (International edition) Mc Graw Hill.

Reference Books:

1. Fundamental of Engineering mechanics (2nd Edition): S Rajasekharan& G Shankara Subramaniam; Vikas Pub. House Pvt ltd.
2. Engineering mechanics: K. L. Kumar; Tata MC Graw Hill.

Course Outcomes:

- Practice free body diagrams and determine the resultant of forces and/or moments.

- Solve the problems involving dry friction.
- Determine the centroid and second moment of area of sections.
- Apply Newton's laws and conservation laws to elastic collisions and motion of rigid bodies.
- Evaluate the various parameters in projectile motion.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	1	1							
CO2	3	2	1	1	1							
CO3	2	1			3							
CO4	3	2	1	2	1	2						
CO5	3	2	2	2	1	1	1	1	2	2	2	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	3	2	1	1	1	1	0	0	0	0	0	0

SESSIONALS

PHYSICS LABORATORY

1. Determination of 'g' by bar pendulum.
2. Verification of laws of transverse vibration of a string by using sonometer
3. Determination of surface tension of water by capillary rise method.
4. Thermal conductivity of a bad conductor by Lee's method
5. Determination of Young's Modulus of wire by Searle's method.
6. Determination of Rigidity modulus of wire by static method.
7. Output characteristic of BJT
8. Determination of wavelength of monochromatic sources using Newton's ring
9. Determination of grating element of a plane diffraction grating using spectrometer
10. Determination of Planck's constant

COURSE OUTCOMES:

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Program Articulation Matrix row for this Course

SECOND SEMESTER

THEORY

Mathematics-II (Differential Equations and Complex Variables)

Module 1: Differential Equations(8 Lectures)

Exact ODEs, integrating factors, linear ODEs, Bernoulli equation, homogeneous linear odes of second order, homogeneous linear ODEs with constant coefficients, Euler-Cauchy equations, non-homogeneous ODEs, Applications Of ODEs to electric circuits

Module 2: Power Series Solution of Differential Equations(8 Lectures)

Series solution of differential equation (excluding Frobenius method), Legendre's equation, Legendre polynomials. Bessel's Equation, properties of Bessel's functions, Bessel Functions of the first and Second Kind.

Module 3: Complex Variables (8 Lectures)

Complex valued function, differentiation, analytic function, Cauchy-Riemann equations, harmonic and conjugate harmonic functions, exponential function, trigonometric and hyperbolic functions, logarithm, general power

Module 4: Complex Variables (8 Lectures)

Line integral in the complex plane, Cauchy's integral theorem, Cauchy's integral formula, power series, radius of convergence, Taylor and Maclaurin series, singularities and zeros, Laurent series, Cauchy residue theorem (statement only) and applications.

Module 5: Elementary Numerical Methods(8 Lectures)

Solution of algebraic and transcendental equations by Newton-Raphson and secant method. Interpolation: Lagrange's method, divided difference method, Newton's forward and backward method. Numerical Integration: Trapezoidal and Simpson's Rule. Numerical solutions of differential equations: Euler's method and improved Euler's method.

Text Book:

- 1) Erwin Kreyszig, Advanced Engineering Mathematics, Wiley India Pvt. Ltd, 9th edition.

Reference Books:

- 1) K.A. Stroud, Advanced Engineering Mathematics, Industrial Press
- 2) Milton Abramowitz and Irene A. Stegun, *Handbook of Mathematical Functions*, National Bureau of Standards, Applied Mathematics Series - 55
- 3) J. Sinha Roy and S. Padhy, Ordinary and Partial Differential Equation, Kalyani Publisher.
- 4) B.V. Ramana, Higher Engineering Mathematics, McGraw Hill

COURSE OUTCOMES:

CO1: Consider adequate knowledge of the effective mathematical tools for the solutions of differential equations that models various physical processes.

CO2: Practice the basic knowledge of power series solution of differential equations.

CO3: Employ fundamental idea of analytic functions and applications of Cauchy-Riemann equations.

CO4: Apply the tools of integration of complex valued functions, and able to get Taylor and Laurent series expansions of functions that is useful in various fields of engineering problems.

CO5: Compile the techniques of extract of roots of algebraic and transcendental equations, and also able to evaluate the integrals by Trapezoidal and Simson's rules.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO												

Chemistry

Course Outcomes:

CO1: Apply the basic concept of classical mechanics and quantum chemistry to real life applications & to understand the basic concept of electromagnetic radiation, spectroscopic techniques and their applications.

CO2: Simulate the spontaneity/feasibility of a process applying thermodynamics concepts and to keep up with the idea of phase equilibria, phase rule and its application to one and two component system.

CO3: Propose the application of electrochemistry to commercial electrochemical cell and corrosion.

CO4: Use the basic concept of kinetics of a reaction to complex reactions.

CO5: Practice the properties and applications of organometallics and nanomaterials.

Module-I

(9 Hours)

Schrodinger Wave equations (not to be derived), Application to particle in ID box.

Molecular rotational (microwave) spectroscopy: Basic principle and application to diatomic molecules, selection rules.

Molecular vibrational (IR) spectroscopy: Basic principle, types of vibrations and vibrational frequency, application to Harmonic and anharmonic oscillators, selection rules, modes of vibration.

CO5												
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Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO												

BASIC ELECTRONICS

MODULE	CONTENT	HOURS
MODULE 1	<p>Introduction to Electronics: - Signals, Frequency Spectrum of Signals, Analog and Digital Signals,</p> <p>Linear Wave Shaping Circuits: - RC LPF, Integrator, RC HPF, Differentiator.</p> <p>Properties of Semiconductors: - Intrinsic, Extrinsic Semiconductors, Current Flow in Semiconductors,</p> <p>Diodes: - p-n junction theory, Current-Voltage characteristics, Analysis of Diode circuits, Rectifiers,</p> <p>Clippers, Clampers, Special diodes- LED, Photo diode, Zener Diode.</p>	(12 Hours)
MODULE 2	<p>Bipolar junction Transistor (BJTs):- Device Structure and Operation, Current-Voltage Characteristics, BJT as an Amplifier and as a Switch. Introduction to Power Amplifiers: - A,B and C types.</p> <p>JFET:- Physical Structure, Operation and Characteristics</p>	(10 Hours)
MODULE 3	<p>Feedback Amplifiers: - General Feedback Structure, Properties of Negative Feedback, Four Basic Feedback Topologies (block diagram only), Practical feedback circuit.</p> <p>Operational Amplifiers (OP-AMPS): - The Ideal OP-AMP, Inverting Configuration, Non-Inverting Configuration. OP-AMP Applications (Adder, Subtractor, Integrator, Differentiator).</p>	(08 Hours)
MODULE 4	<p>Digital Fundamentals:- Binary Numbers, Signed-binary numbers, Decimal-to-Binary & Binary-to-Decimal Conversion, Binary Addition, Subtraction, Multiplication and Division, Hexadecimal Number Systems, Logic Gates, Boolean Algebra, De Morgan's Theorems, Laws of Boolean Algebra, RS Flip Flop</p>	(06 Hours)
MODULE 5	<p>Introduction to Electronic Instruments: - CRO: CRT, Waveform Display, Applications of CRO, Electronic Multimeter, Audio Signal Generator: - Block diagram, Front Panel Controls.</p> <p>Principles of Communication:- Fundamentals of AM & FM, Block diagram of Transmitters</p>	(06 Hours)
TEXT BOOK	<p>1. Microelectronics Circuits, A.S Sedra, K.C. Smith, Oxford University Press. Selected portions from chapters 1 to 3, 5, 8, 13.</p> <p>2. Electronics Fundamentals and Applications, D Chattopadhyay and P.C. Rakshit, New Age International Publications. Selected portions from chapters</p>	

PROGRAMMING FOR PROBLEM SOLVING

Module I:

(8 Lectures)

Introduction to computing- Block architecture of a computer, fundamental units of storage: bit, bytes, nibbles, word size. Introduction to problem solving- Basic concepts of an algorithm, program design methods, flowcharts. Level of programming Languages, structure of C program, Compiling and Executing C program

Module II:

(8 Lectures)

C Language Fundamentals- Character set, Identifiers, Keywords, Data Types, Constant and Variables, Statements. Input &Output - Input & Output Assignments, Formatted Outputs. Operators and Expressions-Operators, Precedence of operators. Decision Control Structure, Loop Control Structure and Case Control Structure.

Module III:

(8 Lectures)

Functions: Monolithic vs Modular programs, User defined vs standard functions, formal vs Actual arguments, Functions category, function prototypes, parameter passing, Recursion.Arrays1D Array, 2D Array & Multi-Dimensional Array. Strings- Declaration & Initialization, String Handling Functions.

Module IV:

(8 Lectures)

Pointer variable and its importance, Pointer Arithmetic, Passing parameters, pointer to pointer, pointer to function. Dynamic Memory Allocation. Structure, Nested Structure, Array of Structures, Pointer to Structure, Structure & Functions, Union, Array of Union Variables, Union inside Structure, Bit Fields. Storage Class.

Module V:

(8 Lectures)

Preprocessor Directives- Types, Pragma Directives, Conditional Directives. typedef, Enumerated Data Type. Files- Reading data from Files, Reading data from Files, Writing data to Files, Error Handling during File Operations. Advanced Issues in Input & Output – using argc&argv.

Text Books:

1. Programming in ANSI C, E Balaguruswamy
2. Computer Fundamentals & Programming in C: ReemaThareja, Oxford University Press.

Reference Books:

1. Let us C- Y.Kanetkar, BPB Publications.
2. Programming with ANSI and Turbo C- Kamthane, A.N. Pearson Education
3. C How to Program- Deitel and Deitel, Pearson Education.
4. The C Programming Language- Brian W. Kernighan and Dennis M. Ritchie, PrenticeHall.

Basic of Civil Engineering

Module-II

Introduction to Civil Engineering – Various disciplines of Civil engineering, Importance of Civil engineering in infrastructure development of the country.

Introduction to types of buildings as per NBC, Selection of site for buildings, Components of a residential building and their functions, Introduction to Industrial buildings and types.

Building Planning – Basic requirements, elements, introduction to various building area terms, computation of plinth area, carpet area.

Module-II

Surveying – Principle and objectives, Instruments used, Horizontal measurements, Ranging (direct ranging only), Instruments used for ranging, Leveling – Definition, Principles, Instruments, Preparation of level book, problems on leveling, Modern surveying instruments – EDM, Total station, GPS (Brief discussion)

Building Materials – Bricks, properties and specifications, Cement – Types, properties, grades, other types of cement and uses, Cement mortar – Constituents, Preparation, Concrete – PCC and RCC, Grades, Steel – Use of steel in buildings, types.

Module-III

Building Construction – Foundations, Classification, Bearing Capacity of Soil and related terms (definition only), Masonry Works – classifications, definition of different technical terms, Brick masonry – types, bonds, general principle, Roofs – functional requirements, basic technical terms, roof covering material, Floors – function, types, flooring materials(brief discussion), Plastering and Painting – objectives, types, preparation and procedure of application.

Module-IV

Basic Infrastructure services – air conditioning & purpose, fire protection & materials, Ventilation, necessity & functional requirements, Lifts, Escalators.

Introduction to planning and design aspects of transportation engineering, Transportation modes, Highway engineering – historical development, highway planning, classification of highway, Railway Engineering – cross section of rail track, basic terminology, geometric design parameter(brief discussion only).

Module-V

Airport engineering – development, types, definition, characteristics of aircraft, basic terminology, Traffic engineering – traffic characteristics, traffic studies, traffic operations (signals, signs, markings), Urban engineering – classification of urban road.

Irrigation & Water Supply Engineering – Introduction, Types of Irrigation, different types of hydraulic structures, dam and weirs, types of dam, purpose and functions.

Text Books:

- Basic Civil engineering, Gopi, S., Pearson Publication
- Basic Civil Engineering, Bhavikatti, S. S., New Age.

Reference Books:

- Construction Technology, Chudley, R., Longman Group, England
- Basic Civil and Environmental Engineering, C.P. Kausik, New Age.
- American Society of Civil Engineers (2011) ASCE Code of Ethics – Principles Study and Application

Course Outcomes:

- Analyze the fundamental aspect of building planning.
- Summarize general aspect of building material and surveying.
- Explain about building constructions.
- Judge transportation modes and planning.
- Describe about Airport & Irrigation Structures.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	3	1	1							
CO2	3	2	1	1	1							
CO3	2	1			3							
CO4	3	2	1	2	1	3						
CO5	3	2	3	2	1	1	3	1	2	2	2	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	3	2	2	1	1	1	1	0	0	0	0	1

SESSIONALS

Chemistry Laboratory

List of Experiments to be done (Any ten Experiments)

1. Determination of amount of sodium hydroxide and sodium carbonate in a Mixture.
2. Determination of Total hardness of water by EDTA method.
3. Estimation of calcium present in the limestone.
4. Standardization of KMnO_4 using sodium oxalate.
5. Determination of ferrous iron in Mohr's salt by potassium permanganate.
6. Determination of Rate constant of acid catalyzed hydrolysis of ester.
7. Determination of dissolved oxygen in a sample of water.
8. Conductometric titration of strong acid and strong base
9. Determination of Viscosity of lubricating oil by red wood Viscometer.
10. Determination of Flash point of given oil by Pensky Marten's Flash Point Apparatus.
11. Determination of available chlorine in bleaching powder.

12. Preparation of acidic and basic buffer solution and measurement of P^H using P^H meter

Book Recommended:

B. Tech Practical Chemistry-Kalyani Publisher.

Course Outcomes:

- Develop knowledge of concepts and applications of chemistry, important laboratory analytical techniques, and instrumentation.
- Revise fundamental principles for environmental analytical methods.
- Identify suitable analytical techniques for analyzing a specific compound in a sample.
- Use suitable techniques for sampling and handling of environmental and chemical samples.
- Explain quality control on chemical analysis and laboratory work and its importance
- Evaluate Hands on training on using different laboratory apparatus and equipments including data analysis and conclusions.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO												

BASIC ELECTRONICS LAB

Experiment No.	CONTENT
1	Familiarity with electronic components and devices(Testing of semiconductor diode, Transistor, IC Pins connection) Digital Multimeter should be used.
2	Study and use of CRO to view waveforms and measure its Amplitude and Frequency.
3	Frequency response of LPF and HPF.
4	V-I Characteristics of a Semiconductor Diode. Determining DC and AC resistance.
5	Clipper Circuit.

6	Clamper Circuit.
7	Half Wave and Full Wave Rectifier without Capacitor filter. Record of Waveforms, Measurement of Average and RMS value.
8	V-I (Output) Characteristics of N-P-N/P-N-P Transistor in CE Configuration.
9	OP-AMP: Inverting and Non-Inverting Configuration. Record of Waveforms.
10	Verification of Truth table of Logic gates (AND, OR, NOT, NAND, NOR, EX-OR)
SUPPLEMENTARY BOOK	1. Integrated Electronics, Millman and Halkias, TMH Publications. 2. Electronic Devices & Circuit Theory, R.L Boylestad and L. Nashelsky, Pearson Education.
<u>SESSIONAL OUTCOME:</u>	
<ol style="list-style-type: none"> 1. Assess basic knowledge on electronic devices and components 2. Design different electronics circuits using semiconductor diodes. 3. Analyze and develop the characteristics of BJT and FET Circuits 4. Use Operational amplifier circuits. 5. Explain basic digital logic gates. 	

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO												

PROGRAMMING FOR PROBLEM SOLVING LAB

1. WAP to display student's data.
2. Input the roll no., name & marks in 4 subjects of a student. Calculate and print the total and average respectively.
3. [WAP to Find LCM of two Numbers](#)
4. WAP using do- while loop to display the square & cube of 1st n natural nos.
5. [WAP to display prime numbers between Two Intervals](#)
6. WAP [to print Pascal's triangle](#)

7. WAP of Simple Calculator using switch Statement
8. WAP to convert binary number to decimal
9. WAP [to calculate the power using recursion](#)
10. WAP to add two matrix using multi-dimensional arrays
11. [WAP to Find the Frequency of Characters in a String](#)
12. WAP to reverse an array using pointers
13. WAP to store information using structures with dynamically memory allocation
14. WAP to create a sequential file Inventory.dat storing the inventory data. The file contains the name of the product, nos, price & quantity for 10 items. WAP to read the records created & print the records along with the value of each item.

Course Outcomes:

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO												

Engineering Graphics & Design

Course Content

Module-I

Introduction to Engineering Drawing: Drawing instruments, lines, lettering and dimensioning.

Scales: Plain, Diagonal and Vernier Scales.

Module-II

Curves: Parabola, Ellipse, Hyperbola, Cycloid, Epicycloid, Hypocycloid and Involute.

Module-III

Orthographic Projections: Concepts, Orthographic projections of points, Lines, Planes and Solids. Sections of solids; Development of surfaces

Module-IV

Isometric Projections: Principles, Isometric Scale, Isometric Views, Isometric Views of lines, Planes, Simple and compound Solids.

Module-V

Introduction to Auto-Cad:

Curves: Parabola, Ellipse, Hyperbola, Cycloid, Epicycloid, Hypocycloid and Involute

Reference Books:

1 Engineering drawing by N.D. Bhatt and V.M Panchal, Charotar Publishing House, Anand.

Engineering Drawing by Venugopal, New Age publisher.

Course Outcomes:

1. Revise basics of engineering drawings and curves.
2. Use Orthographic projections of Lines, Planes, and Solids.
3. Apply Sectioning of various Solids and their representation.
4. Change Pictorial views to Orthographic Projections
5. Construct Isometric Scale, Isometric Projections and Views.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	1	1							
CO2	3	2	1	1	1							
CO3	2	1			3							
CO4	3	2	1	2	1	2						
CO5	3	2	3	2	1	1	2	1	2	2	2	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	3	2	1	1	1	1	0	0	0	0	0	0

3rd Semester

Mathematics-III

(Transforms, Probability and Statistics and Multivariate Analysis)

Module 1: Laplace Transforms (10 Lectures)

Laplace transforms, inverse transforms, linearity, shifting, transforms of derivatives and integrals, solution of ODEs, unit step function, Dirac's delta function, differentiation and integration of transforms, convolution, integral equations.

Module 2: Fourier Transforms (8 Lectures)

Basic concept of Fourier integral, Fourier sine and cosine integral, condition of convergence, Fourier transformation, Fourier sine transform, Fourier cosine transform, properties.

Module 3: Probability (6 Lectures)

Random variables, probability distributions, mean and variance, Binomial, Poisson and hyper-geometric distributions, Normal distribution.

Module 4: Statistics(8 Lectures)

Random sampling, point estimation of parameters, maximum likelihood estimation, confidence intervals, testing of hypotheses for mean and variance, correlation and regression.

Module 5: Multi-variate Analysis(8 Lectures)

Line integrals, double integrals, change of order, Green's theorem(statements only), surface integrals, triple integrals, Divergence theorem of Gauss(statements only), Stoke's theorem(statements only) and applications.

Text Book:

Erwin Kreyszig, Advanced Engineering Mathematics, Wiley India Pvt. Ltd, 9th edition

Reference Books:

- 1) B.V. Ramana, Higher Engineering Mathematics, McGraw Hill
- 2) K.A. Stroud, Advanced Engineering Mathematics, Industrial Press

COURSE OUTCOMES:

CO1: Revise basic knowledge of Laplace and Fourier transforms, and able to solve differential equations by using Laplace transforms.

CO2: Develop knowledge of different methods of proofs for learning advanced Engineering Mathematics.

CO3: Apply Binomial, Poisson and Normal distributions in probabilistic models.

CO4: Explain random sampling and estimation of parameters.

CO5: Experiment the mathematical tools useful in evaluating multiple integrals and applications.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO												

Mechanics of Materials

Course Content

Module-I

Simple Stresses and Strains-

Load, Stress, Principle of St. Venant, Strain, Direct stress, Hooke's Law, Modulus of Elasticity, Stress and strain diagram of mild steel, Elasticity and plasticity - Types of stresses and strains, Working stress, Factor of safety, Lateral strain, Bars of varying section, statically indeterminate problems, Composite bars, Temperature stresses. Strain Energy, Resilience.

Shear stress-

Shear stress, Complementary shear stress, shear strain, modulus of rigidity, Derivation of formula for Shear stress distribution across various beam sections like rectangular, circular, triangular, I, T, angle sections, Shear centre

Relationship between elastic constants

Module-II

Flexural Stresses-

Theory of simple bending, Assumptions, Derivation of bending equation: $M/I = f/y = E/R$, Neutral axis, Determination of bending stresses, Section modulus of rectangular and circular sections (Solid and Hollow), I, T, Angle and Channel sections. Distribution of normal stresses, Composite beam

Torsion-

Torsion in solid and hollow circular shafts, Twisting moment, strength of solid and hollow circular shafts, strength of shafts in combined bending and twisting, closed coil helical spring

Module-III

Compound Stresses and Strains-

Two dimensional system, stress at a point on a plane, principal stresses and principal planes, Maximum shear stresses, Mohr's stress circle, Twodimensional stress-strain system

Principal strains and principal axis of strain, calculation of principal stresses from principal strains, Analysis of strains, Mohr's strain circle, Strain rosettes, determination of principal strains from strain measurements

Module-IV

Thin cylinders and spheres-

Derivation of formulae and calculations of hoop stress, longitudinal stress in a cylinder, and sphere subjected to internal pressures

Buckling of Columns-

Short and long columns with axial load, eccentric loading of columns, core of the section, Euler's theory of initially straight columns with various end conditions

Combined bending and direct stress

Module-V

Theories of failure-

Maximum normal stress theory, maximum normal strain theory, maximum shearing strain theory, maximum strain energy theory, maximum distortion energy theory, maximum octahedral shearing stress theory

Reference Books:

1.Strength of Materials by S. P. Timoshenko and D. H. Young, East West Press

2. Strength of Materials by G.H. Ryder, MacmillanIndia Ltd.

3. Mechanics of Materials by E. Popov

Course Outcomes:

1. Apply the formal theory of mechanics of materials to calculate stresses and strains under varying loading conditions
2. Analyze and design the structural members under tension, compression, torsion, bending and combined stresses employing the fundamental concepts of stress, strain and elastic behavior of materials
3. Utilize basic properties of materials to solve isotropic elasticity problems in two dimension
4. Solve engineering problems in accordance with ethical and economic constraints on design of structures
5. Use appropriate materials in design considering engineering properties, sustainability, cost and weight

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1										
CO2	3	2		2								
CO3	2	1			3							
CO4	3	2				3						
CO5	3	2	3	2	1	1	3	1	2	2	2	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	3	2	1	1	1	1	1	0	0	0	0	1

Civil Engineering Materials and Constructions

Module-I

Basic Building Materials I

Aggregate: Classification, Physical and mechanical properties, soundness, alkali-aggregate reaction, thermal properties of aggregate **Bricks and Masonry Blocks:** Types, properties and field and laboratory tests to evaluate quality **Lime:** classification, properties **Cement:** types, Portland cement: chemical composition of raw material, bogue compounds, hydration of cement, role of water in hydration, testing of cements, fly ash: properties and use in manufacturing of bricks and cement.

Module-II

Mortar: Types and tests on mortars. **Concrete:** Production, mix proportions and grades of concrete, fresh, mechanical and durability properties of concrete, factors affecting properties of concrete, tests on concrete, admixtures, **Special concrete:** light weight concrete, high density concrete, vacuum concrete, shotcrete, steel fiber reinforced concrete, polymer concrete, Ferro cement, high performance concrete, self-compacting concrete.

Module-III

Basic Building Materials II

Building stone: classifications, properties and structural requirements; **Wood and Wood products:** Introduction to wood macrostructure, sap wood and heart wood, defects and decay of timber, seasoning and preservation of timber, fire resisting treatment, introduction to wood products- veneers, plywoods, fibre board, particle board, block board, batten boards. **Metals:** Steel: Important properties and uses of Iron (Cast iron, wrought iron and steel), Important tests on steel rebar, aluminum and copper. **Glass:** types and uses, **gypsum:** source, properties, uses; **plastic:** properties and uses, **paint:** types, distemper, varnish, **Adhesive:** Types, **Bitumen:** types, properties and tests.

Module-IV

Basic Building Constructions

Foundation: purpose, types of foundation- shallow, deep, pile, raft, grillage foundation. **Masonry: Brick Masonry:** types of bonds, relative merits and demerits of English, Single Flemish and Double Flemish bond. **Stone Masonry:** General principles, classification of stone masonry and their relative merits and demerits, **Cavity wall:** components and construction, **Arches:** Terminology and classifications Doors and Windows: Types, materials used

Module-V

Finishing, Services and Special constructions

Wall Finishes: Plastering, pointing, distempering and painting: Purpose, methods, defects and their solutions. **Vertical communication:** Stairs: Terminology, requirements of good staircase, classification; ramps, lifts and escalators. **Damp proofing:** causes, effects, prevention and treatments, **Fire resistant construction:** Fire resistant properties of common building materials, requirements for various building components.

Reference Books:

1. A Text-Book of Building Construction, S.P.Bindra and S.P.Arora, Dhanpat Rai Publications
2. Building Materials and Construction, Jena and Sahu, Mc. Graw Hill.
3. Materials for Civil and Construction Engineers, Mamlouk and Zaniewski, Pearson
4. Building Materials and Building Construction, by PC Verghese
5. B. C. Punmia, *Building Construction*, LaxmiPublicaton

Course Outcomes:

1. Classify various civil engineering basic building materials
2. Observe properties of mortar and concrete
3. Use properties of other construction materials
4. Evaluate basic elements in building construction
5. Explain the characteristics of building finishes, services and special constructions.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	3	1	1							
CO2	2	2	1	1	1							
CO3	1	1			1							
CO4	3	2	1	2	1	3						
CO5	3	2	2	2	1	1	1	1	2	2	2	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	2	2	1	1	1	1	0	0	0	0	0	0

Environmental Science and Engineering

Course Content

Module-I

Quantity of water: Sources of water, Per capita demand, design period, population forecast, fluctuation in demand.

General requirement for water supply: Types of intakes, Pumping and Transportation of water.

Quality of water: Physical, chemical and biological characteristics of water and their significance, necessity of treatment, Drinking water standards

Module-II

Basic unit operations and unit processes for surface water treatment: Screening, Plain Sedimentation, Sedimentation aided with Coagulation, Filtration, Disinfection, Softening

Miscellaneous treatments (principles only): Removal of colours, tastes and odours, removal of iron and manganese, fluoridation and defluoridation, Ion exchange, electro-dialysis, RO

Module-III

Quantity and characteristics of wastewater, effluent discharge standards.

Domestic wastewater treatment: Primary treatment, Screening, Grit removal, Sedimentation, Sedimentation aided with coagulation. Secondary treatment: Basis of microbiology, Growth and food utilization, Suspended-culture systems, Attached-culture systems, Secondary clarification, Disinfections of effluents. Sludge treatment and disposal: Sludge characteristics, thickening, disposal

Module-IV

Air pollution: Units of measurement, Sources and Classification of air pollutants. Influence of meteorological phenomena on air quality: Lapse rate and dispersion, Engineered systems for air pollution control: Gravitational settling chamber, cyclone, ESP, Bag filter and scrubbers, National Ambient air quality standards.

Noise Pollution: Impacts of noise, permissible limits of noise pollution, measurement of noise and control of noise pollution.

Module-V

Solid waste management: Source, classification, characteristics, generation, collection, Storage and transport of MSW, MSW management, Waste minimization of MSW, Reuse and recycling, Biological & thermal treatment (principles only), land fill

Reference Books:

1. Environmental Engineering (Volume I & II) by S. K. Garg-Khanna Publishers
2. Environmental Engineering (Volume I & II) by B. C. Punmia-Khanna Publishers
3. Environmental Engineering by H. S. Peavy, D.R. Rowe and G. Tchobanoglous, MGH.

Course Outcomes:

1. Review sources of water, general requirement for water supply and characterize water.
2. Examine the principles of water treatment and design treatment units.
3. Report the principles of waste water treatment and design treatment units.
4. Identify and quantify noise and air pollutants
5. Explain components of solid waste management and evaluate recovery, treatment and disposal alternatives.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	3	1	1							
CO2	2	2	1	1	1							
CO3	2	1			2							
CO4	2	2	1	2	1	3						
CO5	2	2	3	2	1	1	2	1	2	2	2	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	2	2	2	1	1	1	0	0	0	0	0	0

ORGANIZATIONAL BEHAVIOUR Credit- 2-0-0 Class Hours - 20

Unit Contents Class Hours

Unit 01 Fundamentals of OB: Definition, scope and importance of OB, Relationship between OB and the individual, Evolution of OB, Theoretical framework (cognitive), behavioristic and social cognitive), Limitations of OB.

Unit 02 Attitude: Importance of attitude in an organization, Right Attitude, Components of attitude, Relationship between behavior and attitude, Developing Emotional intelligence at the workplace, Job attitude, Barriers to changing attitudes.

Personality and values: Definition and importance of Personality for performance, The Myers-Briggs Type Indicator and The Big Five personality model, Significant personality traits suitable to the workplace (personality and job – fit theory), Personality Tests and their practical applications.

Perception: Meaning and concept of perception, Factors influencing perception, Selective perception, Attribution theory, Perceptual process, Social perception (stereotyping and halo effect).

Motivation: Definition & Concept of Motive & Motivation, The Content Theories of Motivation (Maslow's Need Hierarchy, Aldefer ERG theory& Herzberg's Two Factor model Theory).

Unit 03 Foundations of Group Behavior: The Meaning of Group & Group behavior& Group Dynamics, Types of Groups, The Five – Stage Model of Group Development. Managing Teams: Why Work Teams, Work Teams in Organization, Developing Work Teams, Team Effectiveness & Team Building. Leadership: Concept of Leadership, Styles of Leadership, Trait Approach Contingency Leadership Approach, Contemporary leadership, Meaning and significance of contemporary leadership, Concept of transformations leadership, Contemporary theories of leadership, Success stories of today's Global and Indian leaders.

Unit 04 Organizational Culture : Meaning & Definition of Organizational Culture, creating & Sustaining Organizational Culture, Types of Culture (Strong vs. Weak Culture, Soft Vs. Hard Culture & Formal vs. Informal Culture), Creating Positive Organizational Culture, Concept of Workplace Spirituality.

Unit 05 Organizational Change: Meaning, Definition & Nature of Organizational Change, Types of Organizational Change, Forces that acts as stimulants to change. Implementing Organizational Change : How to overcome the Resistance to Change, Approaches to managing Organizational Change, Kurt Lewin's-Three step model, Seven Stage model of Change &Kotter's Eight-Step plan for Implementing Change, Leading the Change Process, Facilitating Change, Dealing with

Reference Books

1. Understanding Organizational Behaviour, Parek, Oxford
2. Organizational Behaviour, Robbins, Judge, Sanghi, Pearson.
3. Organizational Behaviour, K. Awathappa, HPH.
4. Organizational Behaviour, VSP Rao, Excel
5. Introduction to Organizational Behaviour, Moorhead, Griffin, Cengage.
6. Organizational Behaviour, Hitt, Miller, Colella, Wiley

Course Outcomes

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO												

SESSIONAL

Concrete Lab

Course Content

1. Fineness of Cement by Sieve analysis and by air permeability method.
2. Standard consistency & Setting times of cement
3. Specific gravity & Soundness of cement
4. Compressive strength of cement
5. Shape size test, Water absorption & Compressive strength of Brick
6. Grain size distribution, Specific gravity and water absorption of fine and coarse aggregates.
7. Unit mass and Voids of concrete aggregates and Bulking of fine aggregates
8. Slump test & Compaction factor test of wet concrete.
9. Stress-strain curve, modulus of elasticity, and poisson's ratio of concrete.
10. Modulus of Rupture of concrete
11. Flexural strength and split tensile strength tests of concrete.

Course Outcomes:

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1											
CO2											
CO3											
CO4											
CO5											

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO												

Environmental Science Lab.

Course Content

1. Determination of Taste, Odour and Color of water/wastewater sample
2. Determination of pH, Temperature, E. Conductivity and D.O. of water/wastewater sample
3. Determination of TS, TDS and SS of water/wastewater sample
4. Determination of hardness & alkalinity of water sample
5. Determination of Turbidity and SO_4^{2-} of water sample
6. Determination of Ca^{+2} , Na^+ and K^+ of water sample
7. Determination of residual chlorine and Cl^- of water sample
8. Determination of BOD of water/wastewater sample
9. Determination of COD of water/wastewater sample
10. Microbiological analysis of water/wastewater sample

Course Outcomes:

1. Determination of physical characteristics of water.
2. Determination of chemical characteristics of water.
3. Determination of biological characteristics of water.
4. Determination of physical characteristics of wastewater.
5. Determination of chemical and biological characteristics of wastewater.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2		2	2	1				
CO2	3	3	3	2			3					
CO3	2	3	2	3	1		2					
CO4	2	2	2	3			2			1		
CO5	3	2	3	2	1	2	3	1	2		1	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	2	2	2	2	0	1	2	0	0	0	0	0

Subject Name: Engineering Graphics & Design

Course Content

Module-I

Introduction to Engineering Drawing: Drawing instruments, lines, lettering and dimensioning.

Scales: Plain, Diagonal and Vernier Scales.

Module-II

Curves: Parabola, Ellipse, Hyperbola, Cycloid, Epicycloid, Hypocycloid and Involute.

Module-III

Orthographic Projections: Concepts, Orthographic projections of points, Lines, Planes and Solids. Sections of solids; Development of surfaces

Module-IV

Isometric Projections: Principles, Isometric Scale, Isometric Views, Isometric Views of lines, Planes, Simple and compound Solids.

Module-V

Introduction to Auto-Cad:

Curves: Parabola, Ellipse, Hyperbola, Cycloid, Epicycloid, Hypocycloid and Involute

Reference Books:

1 Engineering drawing by N.D. Bhatt and V.M Panchal, Charotar Publishing House, Anand.

Engineering Drawing by Venugopal, New Age publisher.

Course Outcomes:

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

1. Understand basics of engineering drawings and curves.
2. Understand Orthographic projections of Lines, Planes, and Solids.
3. Sectioning of various Solids and their representation.
4. Conversion of Pictorial views to Orthographic Projections
5. Construction of Isometric Scale, Isometric Projections and Views.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	3	1	1							
CO2	2	2	1	1	1							
CO3	2	1			3							
CO4	3	2	1	2	1	2						
CO5	3	2	3	2	1	1	2	1	2	2	2	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	2	2	2	1	1	1	0	0	0	0	0	0

Computer Application in Civil Engineering

Course Content

MATLAB: Introduction to MATLAB, Application of MATLAB software for: calculation and plotting SFD and BMD of beam and frame structures. Calculation and plotting of ILDs, plotting of contours

AUTOCAD: Introduction to AUTOCAD, basic commands for 2D drafting, Dimensioning, Layers and Blocks, Basic drawing using AUTOCAD, Simple building drawing using AUTOCAD, Single and multi storey building (plan, section and elevation and 3D view).

INTRODUCTION TO GRAPHIC SOFTWARE: Basic commands, plotting of graphs and data analysis.

Course Outcomes:

1. Use Plotting of SFD and BMD for beam and frame structures.
2. Explain Plotting of graphs, contours and calculation of statistical information for data.
3. Evaluate Drawing of plan, elevation, section and 3D view for a building.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	1	1							
CO2	1	2	1	1	1							
CO3	2	1			3							
CO4	3	2	1	2	1	1						
CO5	3	2	3	2	1	1	1	1	2	2	2	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	2	2	1	1	1	0	0	0	0	0	0	0

4TH Semester

Structural Analysis - I

Course Content

Module-I

Introduction to statically determinate/ indeterminate structure with reference to 2D and 3D structures, free body diagram of structure, introduction to kinematically determinate/indeterminate structures with reference to 2D and 3D structures

Module-II

Bending moment and Shear Force Diagrams for statically determinate beams:

Bending moment (BM) and shear force (SF), BM and SF diagrams for cantilevers, simply supported with or without overhangs under different types of loadings. Relationship between

B.M, S.F and loading.

B.M. shear and normal thrust of three hinged arches

Suspension Cables: Three hinged stiffening girders

Module-III

Introduction to method of superposition, strain energy, virtual work, reciprocal theorem and Castigliano's theorem

Deflection of statically determinate beams: Integration method, Moment area method, Conjugate beam method, strain energy method, unit load method.

Deflection of pin-jointed trusses using strain energy method, unit load method

Module-IV

B.M. and S.F. diagrams for statically indeterminate beams – propped cantilever and fixed beams using consistent deformation/moment area method

B.M. and S.F. diagrams for continuous, propped cantilever and fixed beams using three moment theorem

Module-V

ILD for determinate beams for reactions at supports, S.F. at given section, B.M. at a given section, Maximum shear and maximum bending moment at given section, Problems relating to beams, three hinged arch, suspension cables, stiffening girders.

Text Book:

1. Structural Analysis – Norris & Wilber

2. Indeterminate Structures – J.S. Kenney

Reference Books:

1. Structural Analysis – C.S.Reddy, TMH Publication

Course Outcomes:

1. Explain various internal forces like axial force, shear force and bending moment in structures
2. Determine internal forces in statically determinate structures like beams, arches, cables and stiffening girders
3. Evaluate deformation of statically determinate beams and in pin-jointed plane trusses using appropriate methods
4. Use internal forces in the statically indeterminate beams like propped cantilever beam, fixed beam and continuous beam
5. Solve various internal forces due to rolling or moving loads and their maximum influence on determinate beams, arches, cables with stiffening girders

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	3	1	1							
CO2	1	2	1	1	1							
CO3	2	1			3							
CO4	2	2	1	2	1	2						
CO5	3	2	3	2	1	1	1	1	2	2	2	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	2	2	2	1	1	1	0	0	0	0	0	0

Surveying and Geomatics

Course Content

Module-I

Geo-informatics – (Definition & Importance, Concept of Geoid and reference spheroids, Coordinate Systems), **Basic Surveying** – (Definition & Objective, Plane and Geodetic Surveys, General Classification of Surveys and its Principles), **Surveying Errors** – (Sources, Types of errors and their treatment, Accuracy), **Maps-** (Types, importance, scales, conventional symbols, and generalization; topographic maps, map projection systems), **Idea about measuring Instruments.**

Module-II

Linear Measurements – (Direct and indirect methods, Error and Correction of linear measurement, Optical methods)

Levelling and trigonometric levelling; Levelling: Types of levelling and their uses, permanent adjustment, curvature and refraction effects

Module-III

Angular Measurement – (Principle, Instrument - Compass and Theodolite, Meridian, Bearing & Bearing System, Local attraction, Theodolite traversing, Concept of Latitude and Departure)

Triangulation and Trilateration -

Electronic methods- EDMs, total stations

Module-IV

Curve Survey – (Curve – types & elements, Setting out work)

Photogrammetric - Principle, Scale, flying height, Number of Photographs, Deduction of distance & height scale

Module-V

Remote sensing - basics, platform and sensors, visual image interpretation.

Basics of Geographical information system (GIS) and Geographical positioning system (GPS)

Text Book :

1. Surveying – Punmia, Vol. – I, Laxmi Publication.
2. Surveying – Vol –II – By B.C. Punmia, A K Jain and A K Jain, Laxmi Publishers
3. Higher Surveying – Vol –II By B.C. Punmia, A K Jain, Laxmi Publishers

Reference Books:

- 1.. Surveying (Vol -1 & 2) By S.K. Duggal, Tata McGraw Hill Publishing Co. Ltd. New Delhi
- 2.. Surveying and Levelling by R. Agor, Khanna Publishers

Course Outcomes:

- 1.. Explain Survey data and compute areas and volumes
2. Review the working principles of survey instruments
- 3.. Evaluate measurement errors and apply corrections
- 4.. Relate data collection methods and prepare field notes.
- 5.. Use angles, distances and levels

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	3	1	1							
CO2	3	2	1	1	1							
CO3	2	1			3							
CO4	2	2	1	2	1	3						
CO5	3	2	1	2	1	1	2	1	2	2	2	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	2	2	1	1	1	1	0	0	0	0	0	0

Geotechnical Engineering-I

Course Content

Module-I

Introduction: Origin of soils, formation of soils, clay mineralogy and soil structure, basic terminology and their relations, index properties of soils. Soil classification: Particle size distribution, use of particle size distribution curve, Particle size classification, textural classification, HRB classification, Unified classification system, Indian standard soil classification system, Field identification of soils. capillary tension, capillary siphoning. Stress conditions in soil: Total stress, pore pressure and effective stress

Module-II

Permeability: Darcy's law, permeability, factors affecting permeability, determination of permeability (laboratory and field methods), permeability of stratified soil deposits. Estimation of yield from wells.

Seepage analysis: Seepage pressure, quick condition, Laplace equation for two –dimensional flow, flow net, properties and methods of construction of flow net, application of flow net, seepage through anisotropic soil and non-homogenous soil, seepage through earth dam. Inverted filter and design of inverted filter.

Module-III

Soil compaction: Compaction mechanism, factors affecting compaction, effect of compaction on soil properties, density moisture content relationship in compaction test, standard and modified proctor compaction tests, field compaction methods, relative compaction, compaction control.

Soil consolidation: Introduction, spring analogy, one dimensional consolidation, Terzaghi's theory of one dimensional consolidation, consolidation test, determination of coefficient of consolidation

Module-IV

Shear strength of soils: Mohr's stress circle, theory of failure for soils, determination of shear strength (direct shear test, tri-axial compression test, unconfined compression test, van shear test), shear characteristics of cohesionless soils and cohesive soils.

Module-V

Stabilization of soil: Introduction, mechanical stabilization, cement stabilization, lime stabilization, bituminous stabilization, chemical stabilization, thermal stabilization, electrical stabilization, Introduction to modern methods of stabilization

Reference Books:

Text Book: Geotechnical Engineering, C. Venkatramaiah, New Age International publishers.

Reference Books:

1. Geotechnical Engineering, T.N. Ramamurthy & T.G. Sitharam, S. Chand & Co.
2. Soil Mechanics, T.W. Lambe & Whitman, Wiley Eastern Ltd, Nw Delhi.

Course Outcomes:

- 1 Classify soil and solve three phase soil system.
- 2 Solve any practical problems related to soil stresses estimation, permeability and seepage including flow net diagram.
- 3 Formulate practical problems related to consolidation settlement and time rate of settlement.
- 4 Validate problem related to compaction in the field.
- 5 Use stabilization techniques for soft and expansive soil by using various methods.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	1	1							
CO2	3	2	1	1	1							
CO3	2	1			3							
CO4	3	2	1	2	1	1						
CO5	3	2	1	2	1	1	1	1	2	2	2	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	3	2	1	1	1	0	0	0	0	0	0	0

Fluid Mechanics

Course Content

Module-I

Properties of fluids :Introduction, definition of fluid, development of fluid mechanics, unit of measurement, mass density, specific weight, specific volume, specific gravity, viscosity, vapor pressure, compressibility and elasticity, surface tension and capillarity

Fluid pressure and its measurement: Fluid pressure at a point, variation of pressure in a fluid, Pascal's law, atmospheric absolute, gauge and vacuum pressure, measurement of pressure

Module-II

Hydrostatic forces on surfaces: Total pressure and centre of pressure, total pressure on plane surface(horizontal, vertical, inclined, curved),centre of pressure on vertical and inclined plane surface, pressure diagram, practical application of total pressure and centre of pressure(dam, gate and water tank)

Buoyancy and Flotation: Buoyancy, buoyant force and centre of buoyancy, metacenter and metacentric height, stability of submerged and floating body, determination of metacentric height(experimental and theoretical)

Module-III

Kinematics of fluid flow: Introduction, velocity of fluid particles, types of fluid flow, description of flow pattern, basic principle of fluid flow, continuity equation, acceleration of a fluid particle, rotational and irrotational motion, circulation and vorticity, velocity potential, stream function, stream lines, equipotential lines, flow net , its uses and limitations

Dynamics of fluid flow: Introduction,forces acting on fluid in motion,Euler's equation of motion,Bernoulli's equation of motion,Kinetic energy correction factor,Bernoulli's equation for a compressible fluid,pressure velocity relationship and its application(venture meter,orificemeter,nozzle meter),pitot tube,free liquid jet,vortex motion(free and forced)

Module-IV

Flow through pipes: Introduction, types of flow, laws of fluid friction(laminar flow and turbulent flow),Formulae for head loss due to friction in pipes(Darcy-Weisbachequation,Chezy'sformula,Manning's formula, Hazen-William's formula),other energy losses in pipe,Hydraulic grade line and energy grade line,flow through long pipes, flow through pipes (series,parallel,equivalent,by-pass,branched,syphonic),time of emptying a reservoir through pipe, transmission of power through pipe, flow through nozzle at the end of pipe, water hammer in pipe

Orifices and mouthpieces: Introduction, classification of orifices, flow through an orifice, hydraulic coefficients (velocity, contraction and discharge), flow through large orifices, classification of mouthpieces

Module-V

Laminar flow through pipes:Introduction,relation between shear pressure gradient, steady laminar flow in circular pipe,laminar flow through inclined pipes,laminar flow through annulus, laminar flow parallel plates (both plates at rest, one plate at rest and other moving),variation of friction factor f for laminar flow, laminar flow around sphere, measurement of viscosity(viscometer)

Turbulent flow through pipes: Introduction, shear stress, hydro dynamically smooth and rough boundaries, velocity distribution for turbulent flow in hydro dynamically smooth and rough pipes, criteria for smooth and rough pipes, velocity distribution for turbulent flow in terms of mean velocity for smooth and rough pipes, resistance to flow of fluid in smooth and rough pipes,criteria for hydro dynamically smooth and rough pipes,variation of friction factor for commercial pipes

Text Books:

1. Hydraulics and Fluid Mechanics including Hydraulic Machines by P.N.Modi and S.M. Seth, Standard Book House.

Reference Books:

1. Fluid mechanics by A.K. Jain, Khanna Publishers.
2. Engineering Fluid Mechanics by K.L. Kumar, S. Chand & Co.
3. Fluid Mechanics by V.L. Streeter, MGH

Course Outcomes:

1. Explain about fluid properties and pressure measurement.
2. Analyze hydrostatic forces on surfaces and study of buoyancy and flotation.
3. Revise basics of kinematics and dynamics of fluid flow.
4. Observe flow through pipes and computation of coefficients of orifices and mouthpieces.
5. Differentiate between laminar and turbulent flows through pipe.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	3	1	1							
CO2	2	2	1	1	1							
CO3	2	1			1							
CO4	3	2	1	2	1	3						
CO5	3	2	1	2	1	1	3	1	2	2	2	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	2	2	1	1	1	1	1	0	0	0	0	0

Economics for Engineers

Module-1:

Theory of Demand: Demand and Utility, Demand function and the factors determining demand, Law of Demand, Reasons for downward sloping demand curve, Exceptions to the law of demand. The market forces of Supply and Demand, Elasticity of demand and its application, Utility analysis: cardinal and ordinal measurability of utility, Assumptions of cardinal utility analysis, law of diminishing marginal utility, Consumer's equilibrium: Principle of equi-marginal utility

Module-2:

Indifference curve analysis of demand: Concepts, properties, Equilibrium of the consumer, Price Consumption Curve (PCC) and Income Consumption Curve, Decomposition of price effect into income effect and substitution effect, Revealed preference hypothesis, Individual choice under Risk and Uncertainty: St. Petersburg paradox and Bernoulli's hypothesis, Neumann-Morgenstern method of constructing utility index, Friedman-Savage hypothesis, Markowitz hypothesis

Module-3

Production function: short run analysis, Total product, Average product and Marginal product, output elasticity of input, law of variable proportion, Long run production function: Isoquants and concepts of returns to scale, Optimum factor combinations, Homogeneous Production Function, Cobb–Douglas production function, CES Production function, Cost Analysis: Concepts, Accounting cost, Fixed and variable cost, opportunity cost, Short run and long run cost curves, Relationships between average cost and marginal cost

Module-4

Market and its classifications, Perfect competition: Characteristics, Short run and long run equilibrium of firm under perfect competition. Monopoly market: Price and output determination. Modern theories of firms: Baumol's theory of sales revenue maximisation, Bain's limit pricing model

Module-5

Time value of money: use of cash flow diagram, Annual economic worth, present worth, future worth, Internal Rate of Return (IRR), Net Present Value (NPV), Payback period method, Analysis of public projects: Cost-Benefit analysis, cost effectiveness

Reference Books:

1. Koutsoyiannis, A. (1979). Modern Microeconomics. The Macmillan Press Ltd., London
2. Varian, H. R. (1992). Introduction to Micro Economic Analysis, Norton and company, New York
3. Salvatore, D. (2008). Microeconomics: theory and applications. Oxford University Press
4. Pindyck, R. S., D. N. Rubinfeld and P. L. Meheta (2009). Microeconomics, Pearson India, New Delhi
5. Panneerselvam, R.(2007). Engineering Economics, Prentice-Hall of India, New Delhi
6. Henderson, J. M. and R. E. Quant (2011). Microeconomic Theory: A Mathematical Approach, Indian Higher Education, New Delhi
7. Intriligator, M. D., R. G. Bodkin and C. Hsiao(1995). Econometric Models, Techniques, and Applications, Pearson India, New Delhi

Course Outcomes:

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO												

Sessional

Survey Practice

Course Content

1. Determination of sensitivity of bubble tube
2. (a) Determination of tacheometric constants.
(b) Solution of Height & distance using tacheometer
3. Measurement of distance, angle and height using total station
4. Layout of a building using total station
5. (a)Setting out of simple circular curve and transition curve using total station
(b) Transition Curve 6. Measurement of angles and distances using Differential Global Positioning System (DGPS)

Course Outcomes:

1. Prepare a layout of certain area using different techniques.
2. Use RS & GIS to prepare a map of a certain area.
3. Explain Total Station
4. Evaluate setting out of different Curves

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	1	1							
CO2	3	2	1	1	1							
CO3	2	1			3							
CO4	2	2	1	2	1	3						
CO5	3	2	1	2	1	1	3	1	2	2	2	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	2	2	1	1	1	1	1	0	0	0	0	0

Building Drawing

Course Content

1. Plan, elevation, side view of residential/office building
2. Detailing of doors/windows
3. Drawing of several types of footing, brick work, floor staircase, masonry, arches and lintels.
4. Types of steel roof trusses
5. Drawing of 2 bedroom/3 bedroom houses (single and two storied), ground and first floor plans, elevation and section for load bearing and framed structures
6. Project on establishment like Bank building/Post.
7. Office/Hostel/Library/Auditorium/Factory building etc.
8. Introduction to Auto-CAD: Use of Auto-CAD in building drawing.

Text Books:

1. Civil Engineering Drawing by: M. Chakraborti,

Reference Books:

1. Building Planning and Drawing by N. Kumara Swamy and A. Kameswara Rao, Charotar Publisher.

Course Outcomes:

1. Apply the principles of planning and bylaws used for building planning
2. Use Drawing for plan, section and elevation for various structures.
3. Evaluate several types of footing.
4. Explain staircase.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	3	1	1							
CO2	3	2	1	1	1							
CO3	2	1			1							
CO4	2	2	1	2	1	3						
CO5	3	2	2	2	1	1	2	1	2	2	2	3

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	2	2	1	1	1	1	0	0	0	0	0	1

Geotechnical Engineering Lab

Course Content

1. Determination of specific gravity of soil grains
2. Determination of grain size distribution of soil: (a) sieve analysis; (b) Hydrometer/pipette test
3. Determination of Atterberg limits of soil: (a) liquid limit, (b) plastic limit, (c) shrinkage limit
4. Measurement of unit weight of soil in the field: (a) Core cutter method, (b) Sand replacement method
5. Determination of Density-water content relationship of soil: Proctor compaction tests.
6. Determination of relative density of granular soil
7. Determination of shear strength of soil: (a) Direct shear test (b) Tri-axial shear test, (c) Unconfined compression test (d) Vane shear test
8. Determination of consolidation characteristics of soil using fixed ring Oedometer
9. Determination of California Bearing Ratio (CBR) of soaked and un-soaked soil samples
10. Determination of coefficient of permeability of soil: (a) Constant head Permeameter (b) Falling Head Permeameter

Course Outcomes:

1. Classify soil by physical observation of the soils.
2. Observe soil based on estimated index and engineering characteristics of soils
3. Examine soil properties in field
4. Estimate density water content relationship
5. Measure consolidation and shear parameter to design foundation

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	3	1	1							
CO2	2	2	1	1	1							
CO3	2	1			2							
CO4	2	2	1	2	1	2						
CO5	2	2	2	2	1	1	2	1	2	2	2	2

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	2	2	1	1	1	1	0	0	0	0	0	0

Fluid Mechanics Lab

Course Content

1. Study of discharge measuring, pressure measuring and velocity measuring equipments
2. Verification of Bernoulli's theorem.
3. Determination of Darcy-Weisbach friction factor for pipe flow.'
4. Study of Moody's chart for pipe flow.
5. Study of flow patterns using Reynold's apparatus.
6. Study of free vortex and forced vortex.
7. Determination of coefficient of discharge for venturi meter.
8. Determination of coefficient of discharge for orifice meter.
9. Determination of coefficient of discharge for nozzle meter.
10. Determination of coefficient of discharge, coefficient of velocity and coefficient of contraction for circular orifice.
11. Determination of metacentric height for a ship model.

Course Outcomes:

1. Use various equipments
2. Distinguish pipe flow patterns
3. Determine coefficient of discharge(C_d) for different meters in pipes

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3		2	1			1			
CO2	3	2	3	2	2		1					
CO3	3	3	2	3	3		1		1			

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	3	2	3	2	2	0	1	0	1	0	0	0

Non Credit Subject Name: Environmental Science

Course Content

Module-I

Components of Earth System: Lithosphere, Cryosphere, Atmosphere, Hydrosphere, Biosphere and Outer space.

Ecological concepts and natural Resources: Ecological perspective and value of environment, Environmental auditing, Biotic components, Levels of organizations in environment Ecosystem Process: Energy, Food chain, Environmental gradients, Tolerance levels of environmental factor.

Natural Resources covering Renewable and Non-renewable Resources, Forests, water, minerals, Food and land (with example of one case study); Energy, Growing energy needs, energy sources (conventional and alternative).

Hydrological cycle, water balance, energy budget, precipitation, infiltration, evaporation and evapotranspiration.

Module-II

Environmental Pollution: Definition, Causes, effects and control measures of: Water pollution, Air pollution, Noise pollution, Soil pollution, Marine pollution, Thermal pollution, Nuclear hazards

National Ambient Air quality Standards, Noise standards, Vehicle emission standards

Module-III

Environmental Issues: Climate change, Global warming, Acid rain, Ozone layer depletion, Sustainable development, Bio gas, Natural gas, Biodiversity, Urban problems related to energy, water scarcity, Water conservation, rain water harvesting, artificial recharge, watershed management, carbon trading, carbon foot print

Module-IV

Drinking water standard (IS 10500), Water Quality Criteria and wastewater effluent standards

Water treatment: Water sources and their quality, Lay out of a water treatment plant and working of each unit/ principles of each process i.e. Screening, Aeration, Sedimentation, coagulation, flocculation, Filtration, Disinfection. Miscellaneous treatment: Removal of color, tastes and odour control, removal of iron and manganese, fluoridation and defloridation. Advanced water treatment: Ion exchange, electro-dialysis, RO, desalination

Working principles of ready-made water filter/purification system commercially available

Lay out of a wastewater treatment plant and working of each unit.

Module-V

Solid waste management: Source, classification and composition of Municipal Solid Waste (MSW), Storage and transport of MSW, MSW management, Waste minimization of MSW, Reuse and recycling, Biological & thermal treatment (principles only), land fill

Biomedical Waste management – sources, treatment (principles only) and disposal

Hazardous Waste Management- Introduction, Sources, Classification, treatment (principles only)

Introduction to e-waste management.

Environmental impact Assessment: Project screening for EIA, Scoping studies

Environmental policies and acts (Air, Noise, Water, Forest, E-waste, Hazardous waste acts).

Text Book:

1 1. Environmental Engineering, G. Kiely, TMH, 2007

Reference Books:

1. Environmental Engineering (Volume I & II) by S. K. Garg-Khanna Publishers
2. Environmental Engineering (Volume I & II) by B. C. Punmia-Khanna Publishers
3. Environmental Engineering by H. S. Peavy, D.R. Rowe and G. Tchobanoglous, MGH.
4. Introduction to Environmental Engineering, M. L. Davis and D. A. Cornwell, McGraw Hill International, 2005.

Course Outcomes:

1. Identify different components on environment.
2. Determine environmental pollutions and to find control measures for them.
3. Explain global environmental issues.
4. Revise the principles of water and waste water treatment.

5. Evaluate components of waste management and environmental impact assessment.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	3	1	1							
CO2	3	2	1	1	1							
CO3	2	1			3							
CO4	3	2	1	2	1	3						
CO5	3	2	3	2	1	1	3	1	2	2	2	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	3	2	2	1	1	1	1	0	0	0	0	1

Program Articulation Matrix row for this Course

5th Semester

Reinforced Concrete Design

Course Content

Module-I

Properties of concrete and reinforcing steel, philosophy, concepts and various methods of reinforced concrete design.

Introduction to Limit state method: analysis and design of beams (Single reinforced, double reinforced and flanged sections) for flexure.

Module-II

Analysis and design of beams for shear torsion, bond and deflection.

Module-III

Design of one way and two way slabs, Design of staircases

Module-IV

Design of compression members: Short column, Column with eccentric loading (uni-axial and bi-axial bending) and Long columns using of design charts.

Module-V

Design of foundation: Wall footing, Isolated and combined footing for columns.

All designs to be as per the most recent BIS standards as applicable

Text Books:

1.Reinforced concrete: Limit state by A.K. Jain

2.IS 456,SP-16 and SP-32.

Reference Books:

1. Limit state design of reinforced concrete by P.C. Verghese, PHI
2. Reinforced concrete by B. C. Punmia, A. K. Jain and A. K. Jain

Course Outcomes:

1. Revise the design philosophy and flexural behavior of reinforced concrete beams.
2. Analyze and design of reinforced concrete beams for shear, torsion, bond and deflection.
3. Evaluate design of reinforced concrete slabs and stair cases.
4. Explain design of reinforced concrete short Columns.
5. Use design of foundations.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	3	1	1							
CO2	2	2	1	1	1							
CO3	2	1			2							
CO4	3	2	1	2	1	1						
CO5	3	2	1	2	1	1	1	1	2	2	2	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	2	2	1	1	1	0	0	0	0	0	0	0

Fluid Dynamics

Course Content

Module-I

Module-II

Boundary Layer Theory: Introduction, thickness of boundary layer, boundary layer along a long thin plate and its characteristics, boundary layer equations, momentum integral equations of the boundary layer, laminar boundary layer, turbulent boundary layer, laminar sub-layer, boundary layer on rough surfaces, separation of boundary layer, methods of controlling the boundary layer.

Drag and Lift: Introduction, Types of Drag, dimensional analysis of drag and lift, drag on a (sphere, cylinder, flat plate and air foil), effect of free surface on drag, effect of compressibility on drag, development of lift on immersed body, induced drag on an air foil, of finite length, polar diagram for lift and drag of an air foil.

Module-III

Momentum equation and its applications: Introduction, impulse momentum equation, momentum correction factor, application of impulse momentum equation, force on a pipe bed, jet propulsion (orifice tank, ship), momentum theory of propellers, angular momentum principle

Impact of free jets: Introduction, force exerted by fluid jets on (stationary flat plate, moving flat plate, stationary curved vane, moving curved vane), Torque exerted on a wheel with radial curved vane

Module-IV

Reciprocating Pump: Introduction, main components, types, work done (single acting and double acting), coefficient of discharge, slip, percentage slip and negative slip, effects of

acceleration of piston on velocity and pressure in suction and delivery pipes, indicator diagram, operating characteristic curves

Centrifugal Pump: Introduction, advantages, component parts, working, types, work done by the impeller, head, losses and efficiencies, minimum starting speed, loss of head due to reduced or increased flow, diameter of impeller and pipes, specific speed, characteristic curves, cavitation, priming devices, troubles and remedies

Turbines: Introduction, elements of hydraulic power plant, head and efficiencies of hydraulic turbine, classification.

Pelton wheel: work done and efficiencies, working proportions, design of runner, multiple jet wheel.

Radial flow impulse turbine: reaction turbine, Francis turbine, work done and efficiencies, working proportions, design of runner, draft tube theory, Kaplan turbine, working proportions.

Expression for specific speed in terms of known coefficients for different turbines, performance characteristic curves.

Classification, reaction, impulse, outward flow, inward flow & mixed flow turbines, Francis & Kaplan turbines, Pelton Wheel, Physical description and principle of operation, Governing of turbine.

Module-V

Uniform flow in open channels: Introduction, types, geometrical properties, velocity distribution, uniform flow, most economical section, computation of uniform flow, specific energy and critical depth, specific force, critical flow and its computation, application of specific energy to channel transitions

Non-uniform flow in open channel: Introduction, gradually varied flow, classification of channel bottom slopes, classification of surface profiles, characteristics of surface profiles, integration of varied flow equations, hydraulic jump, location of hydraulic jump, surges in open channel

Flow over notches and weirs: Introduction, classification, sharp-crested weir, rectangular weir, triangular weir, trapezoidal weir, broad-crested weir.

Measurement of depth of flow: point gauge, hook gauge, float gauge

Text Books:

1. Fluid Mechanics by A.K. Jain, Khanna Publishers

Reference Books:

1. Fluid Mechanics and Hydraulic Machines, Modi & Seth, Standard Publishers
2. Introduction to Fluid Mechanics and Fluid Machines, S.K. Som & G. Biswas,

Course Outcomes:

1. Use dimensional analysis and study of viscous incompressible flow
2. Explain boundary layer growth and its application in drag and lift phenomena
3. Express momentum equation and its application in impact of jet
4. Develop velocity triangles for different pumps and turbines
5. Revise basics of open channel flow and detail flow profiles

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	1	1							
CO2	3	2	1	1	1							
CO3	2	1			3							
CO4	3	2	1	2	1	3						
CO5	2	2	3	2	1	1	2	1	2	2	2	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	2	2	1	1	1	1	0	0	0	0	0	1

Geotechnical Engineering- II

Course Content

Module-I

Stress distribution in soil: Boussinesq equations, Stress isobar and pressure bulb concept, pressure distribution on horizontal and vertical planes, stresses due to point load, line load, strip load, uniformly loaded circular and rectangular areas. Use of Newmark's chart. Westergaard's solution. Approximate methods (point load method, two-to-one load distribution method). Contact pressure distribution due to loaded areas. Concept of active zone.

Module-II

Shallow foundation: Introduction, bearing capacity, methods and determination of bearing capacity, settlement of foundations.

Deep foundation: Classification of pile, pile driving methods, pile capacity (static and dynamic analysis) pile-group analysis, load test on piles.

Module-III

Subsoil exploration: Methods, direct (test pits, trenches), semi-direct (borings), indirect (sounding, penetration tests, and geophysical methods). Planning of exploration programme, spacing and depth of boring, soil sampling, types of samples, standard penetration test, static and dynamic cone penetration test, in-situ vane shear test. Seismic refraction method, electrical resistivity methods.

Module-IV

Lateral earth pressure and retaining structures: Earth pressure at rest, active and passive earth pressure. Earth pressure theories, Rankine's theory, Coloumb's wedge theory, Rebhann's and Culmann's graphical methods, stability conditions for retaining walls.

Module-V

Stability of earth slopes: Stability of infinite slopes, stability analysis of finite slopes, Swedish method of slices, fiction circle method, Bishop's method. Use of Taylor stability number. Fellniousmethod for locating centre of critical slip circle.

Text Books:

1. Geotechnical Engineering, C. Venkatramaiah, New Age International publishers.

Reference Books:

1. Geotechnical Engineering, T.N. Ramamurthy & T.G. Sitharam, S. Chand & Co.
2. Soil Mechanics, T.W. Lambe & Whitman, Wiley Eastern Ltd, Nw Delhi.

Course Outcomes:

- 1 Analyze stress distribution due various loading condition
- 2 Explain the earth retaining structures for any kind of soil medium with different loading condition.
- 3 Use the stability analysis of slopes and embankments.
- 4 Evaluate soil investigation for any civil engineering construction.
- 5 Estimate pile and pile group capacity for any kind of soil including group efficiency and negative friction.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2						1	
CO2	2	2	2	2	1					2		
CO3	2	3	3	3	2		1					
CO4	3	2	3	3	2	2		2	2			1
CO5	3	3	2	3	2		1				1	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	3	3	2	3	2	0	0	0	0	0	0	0

Sessional

Structural Engineering Lab

Course Content

1. Determination of tensile strength and percentage of elongation of steel, Stress- strain curve of steel, Modulus of Elasticity.
2. Bend and rebend test of steel reinforcement.
3. Mix design of Concrete as per IS:10262-1982
4. Testing of RCC beam
5. Non-destructive tests of concrete
6. ILD for indeterminate structure
7. Finding reactions and forces for three hinged arch.

Course Outcomes:

1. Connect theory with practice and application by demonstration
2. Practice to get exposure on equipments and machines like UTM, rebound hammer, three and two hinged arch, concrete mixer etc
3. Facilitate all inputs required to help to attain professional expertise to analyze data,

interpret results, and write technical reports

- Summarize the knowledge and application of safety regulations

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	2	3							
CO2	3	2	3	3	2				2			
CO3	3	3	2	3	2				1	2		1
CO4	2	2	3	2		2	2	1	1		1	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	3	2	3	3	2	1	1	0	1	1	0	1

Design of Concrete Structures

Course Content

- Design and detailing of singly and doubly reinforced sections
- Design and detailing of flanged sections
- Design and detailing of slabs: one way, two way, cantilever and continuous
- Design and detailing of staircases
- Design and detailing of axial, uniaxial and biaxial loaded columns
- Design and detailing of isolated footings
- Design and detailing of framed building with different structural elements: manual and using commercial software

Course Outcomes:

- Determine strength of reinforced concrete beams and slabs at various support conditions as per Limit state design
- Design reinforced concrete beams and slabs at various support conditions for different loadings as per Limit state design

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2				1			2
CO2	3	3	3	3	2	2	1		1	1	2	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	3	3	3	3	2	1	1	0	1	1	1	2

Fluid Flow Lab

Course Content

1. Study of discharge measuring, pressure measuring, velocity measuring and depth measuring equipments
2. Determination of Manning's constant, Chezy's constant and Darcy-Weisbach friction factor for open channel
3. Determination of coefficient of discharge for broad crested weir and sharp crested weir.
4. Determination of coefficient of discharge for v-notch and rectangular notch.
5. Determination of specific energy for open channel flow.
6. Study of specific energy applications using hump and width constriction.
7. Establishment of different types of hydraulic jumps & determination of characteristics of the jumps
8. Study of various types of surges and their characteristics.
9. Study of boundary layer growth for open channel flow using velocity profile
10. Determination of percentage of slip and efficiency of the double acting reciprocating pump and draw its characteristic curve
11. Determination of overall efficiency of Francis turbine with constant DC loading
12. Determination of overall efficiency of Pelton turbine under constant speed with alternating load

Course Outcomes:

1. Use various equipments
2. Determine roughness constants in open channel flow
3. Explain coefficient of discharge(Cd) for different weirs and notches
4. Compute specific energy and its applications

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2		2	3							2
CO2	3	3	2	3	2				1			
CO3	3	3	2	2	2		1			1		
CO4	3	3	2	2	2	1	1	2	1		1	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	3	3	2	2	2	0	1	1	1	0	0	1

Programme: B.Tech.

Semester: Fifth

Professional Elective Course(UPE-I)

Subject Name: Advanced Surveying

(3-0-0) CR-03

Course Content

Module-I

Electromagnetic distance measurement (EDM) – Principle of EDM Carrier waves – Types of

EDM instruments – Distomat – Total Station – Principle – procedure & surveying using Total Station – precise leveling - micro-optic theodolite.

Module-II

Photogrammetry – Terrestrial and Aerial Photogrammetry – Horizontal position of a point from photographic measurement – elevation of a point – Determination of focal length of camera - Geometry and scale of vertical photographs – Ground co-ordinates from vertical photographs -

Relief displacement – Planimetric mapping from vertical photos – Stereoscopy–
Photointerpretation.

Module-III

Remote sensing – concepts – Idealized remote sensing system – characteristics – Types of
remote sensing system – Remote sensing from space – Data interpretation – application of
remote sensing – LIDAR – RADAR - SONAR.

Module-IV

Geodesy – Figure of earth – Classification – Earth surface - Geodetic reference surfaces -
Coordinate systems – Geodetic datums and elements – Map – Scale of map – projection – UTM–
Map projection of India – Space Geodesy – VLBI – SLR - LLR.

Module-V

GPS Basics – system overview – working principle of GPS – Satellite ranging –calculating
position – Ranging errors and its correction – GPS surveying Methods – static, Rapid static,
DGPS and Kinematic methods – Real time and post processing DGPS – visibility diagram –
GAGAN.

Text Books:

1. Duggal, S.K. Surveying Vol. II, Tata McGraw Hill.
2. Punmia, B.C. Surveying Vol.III, Standard Publishers.

Reference Books:

1. Arora, K. R. Surveying Vol. III, Standard Book House.
2. SatheeshGopi. Advanced Surveying, Pearson Education.
3. SatheeshGopi. The Global Positioning System and Surveying using GPS, Tata McGraw.

Course Outcomes:

1. Apply advanced surveying techniques in different fields of civil engineering
2. Calculate area of a traverse by using different methods such as triangulation, aerial
photogrammetry.
3. Use RS & GIS to prepare a map of a certain area
4. Explain the principles of the earth surface, its projections and different coordinates involved in
map making
5. Employ GPS in transportation engineering, structural engineering and land use planning

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	1	1							
CO2	1	2	1	1	1							
CO3	2	1			3							
CO4	3	2	1	2	1	3						
CO5	3	2	3	2	1	1	3	1	2	2	2	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	2	2	1	1	1	1	1	0	0	0	0	0

Professional Elective Course(UPE-I)**Subject Name: River Engineering****(3-0-0) CR-03****Course Content****Module-I**

Introduction: The fluvial system, variables for alluvial rivers, rivers, their behavior, control and training: Importance of rivers and necessity of controlling them, types of rivers and their characteristics, Indian rivers and their classification, behavior of rivers,

Module-II

Introduction, The problem of flow in a river, River hydraulics: The one-dimensional equations of hydraulics, Structures, controls, and boundary conditions, Measurement and analysis: Hydrometry and the hydraulics behind it, the analysis and use of stage and discharge measurements,

Computational hydraulics: steady flow, unsteady flow

Module-III

Sediment transport: General, Initiation of motion, Bed forms and alluvial roughness, Transport formulae, unsteady aspects

Module-IV

River morphology: Introduction, Regime concept, channel-forming discharge, hydraulic geometry, meander planform, Longitudinal stream profile, river classifications, thresholds in river morphology, bends, Channel characteristics, Bifurcations and confluences, geomorphic analysis of river channel responses

Module-V

Control and training of rivers: Introduction, Bed regulation, Discharge control, Water level control, Water quality control, Bank protection, dikes, grade-control structures River engineering for different purposes: flood control and drainage, navigation, hydropower, water supply, waste discharge, crossing of other infrastructures, soil conservation, nature preservation and restoration

Text Books:

Chang, H.H. (1988), Fluvial Processes in River Engineering, John Wiley and Sons

Reference Books:

1. Fenton, J. (2011), River Engineering, Institute of Hydraulics and Water Resources Engineering, Vienna University of technology

Course Outcomes:

1. Explain the fluvial system
2. Consider the problem of flow in a river
3. Use sediment transport
4. Revise river morphology
5. Employ control and training of rivers

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	1	1							
CO2	1	2	1	1	1							

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	2	2	1	1	1	1	0	0	0	0	0	1

Programme: B.Tech.

Semester: Fifth

Professional Elective Course(UPE-I)

Subject Name: Industrial Wastewater Treatment

(3-0-0) CR-03

Course Content

Module-I

Types of industries and industrial pollution, Characteristics of industrial wastes, Population equivalent, effects of industrial effluents on streams, sewer, land, sewage treatment plants and human health

Environmental legislations related to prevention and control of industrial effluents and hazardous wastes

Module-II

Industrial Waste survey - Process flow charts, condition of waste stream. Sampling – Grab, Composite and integrated samples. Continuous monitoring – pH, Conductivity, Biomonitoring

Waste management Approach, Waste Audit, Volume and strength reduction, Material and process modifications, Recycle, reuse and byproduct recovery, Zero effluent discharge

Module-III

Sources, Characteristics, waste water treatment flow sheets for selected industries such as Textile, Tannery, Pharmaceutical, Dairy, Sugar, Pulp and Paper, Distillery, Steel plants, Oil refineries, fertilizer

Module-IV

Waste minimization, Equalization, Neutralization, Oil separation, Flotation, Precipitation, Heavy metal Removal, adsorption.

Module-V

Aerobic and anaerobic biological treatment, Sequencing batch reactors, high rate reactors, chemical oxidation, ozonation, Photocatalysis, Wet Air Oxidation, Evaporation, Ion Exchange, Membrane Technologies, Nutrient removal

Text Book:

1. Environmental Engineering (Volume II) by S. K. Garg-Khanna Publishers

Reference Books:

1. Eckenfelder(2000)- "Industrial Water pollution Control"- McGraw hill Company, New Delhi

American Chemical Society, Washington D.C. USA

2. Mahajan (1984) –” Pollution control in Process industries”. TMH, New Delhi.
3. Rao and Dutta (2007)- “Waste Water Treatment”- Oxford & IBH Pulishing Co. Pvt. Ltd., New Delhi
4. Azad N. S., “Industrial Wastewater Management Hand Book” McGraw Hill book Co., Newyork.

Course Outcomes:

1. Explain the characteristics of industrial waste.
2. Summarize the theory required for the industrial wastewater treatment unit processes.
3. Use the waste water treatment flow sheets for different industrial wastes.
4. Revise the principles of primary industrial waste water treatment and design treatment units.
5. Report the principles of secondary and tertiary industrial waste water treatment and design treatment units.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	1	1							
CO2	3	2	1	1	1							
CO3	2	1			3							
CO4	3	2	1	2	1	2						
CO5	3	2	3	2	1	1	2	1	2	2	2	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	3	2	1	1	1	1	0	0	0	0	0	0

Programme: B.Tech.

Semester: Fifth

Open Elective Course (UOE-I)

Subject Name: Remote Sensing and GIS

(3-0-0) CR-03

Course Content

Module-I

Remote Sensing: Introduction, Overview, Applications of remote sensing in Civil Engineering

Module-II

Introduction: Overview, GIS, Applications of GIS in Civil Engineering

Module-III

Introduction to geographic Information Systems: Overview, GIS Basics, Maps and map Data characteristics, User Interfaces and Interaction Modes, GIS System planning and Implementation, GIS Software

Module-IV

GIS Data and Databases: Overview, GIS Data Development and Maintenance, GIS Data Models, Digital Data Sources for Civil Engineering, Geodatabases

Module-V

GIS Analysis Functions and Operations: Overview of GIS Analysis Functions, Spatial Data Capture and Maintenance, Geometrics and Measurements, Spatial and Aspatial Queries; classification, Neighborhood Operations, Spatial Arrangement and Connectivity Functions, Surface Operations, Overlays and Map Algebra, Spatial Statistics, Image Processing, Display, Interfaces, Integration, Management Tools

Text Books:

Lynn E. Johnson (2009) “Geographic Information Systems in Water Resources Engineering” Taylor and Francis Group, CRC Press, Boca Raton, FL.

Reference Books:

Lynn E. Johnson (2014) “GIS and Remote Sensing Applications in Modern Water Resources Engineering” Springer, New York.

Course Outcomes:

1. Explain about application of remote sensing in Civil Engineering
2. Report application of GIS in Civil Engineering
3. Revise basics of GIS
4. Use data development and management in GIS
5. Analyze functions and operations in GIS

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			2			2						
CO2	2	2	2			2				2		
CO3	2	2			2	2		2				
CO4	3	3	3	2	3	3	2		2	2	1	1
CO5	3	3	3	2	3	2	2		1	2		

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	2	2	2	1	2	2	1	0	1	1	0	0

Programme: B.Tech.

Semester: Fifth

Open Elective Course(UOE-I)

Subject Name: Watershed Management

(3-0-0) CR-03

Course Content

Module-I

Introduction and basic concepts: Concept of watershed, Introduction to watershed management, different stakeholders and their relative importance, Watershed management policies and

decision making.

Module-II

Watershed Modelling: Standard modeling approaches and classification, system concept for watershed modeling, overall description of different hydrologic processes, modeling of rainfall runoff process, subsurface flows and groundwater flow.

Module-III

Soil Erosion Modelling: Soil Erosion, Estimation of soil erosion.

Management of Water Quality: Water quality and pollution, types and sources of pollution, water quality modeling, environmental guidelines for water quality.

Module-IV

Storm Water and Flood Management: Storm water management, design of drainage system, flood routing through channels and reservoir, flood control and reservoir operation, case studies of flood damage.

Drought Management: Drought assessment and classification, drought analysis techniques, drought mitigation planning.

Module-V

Integrated Watershed Management: Introduction to integrated approach, conjunctive use of water resources, rainwater harvesting.

Text Books:

E.M. Tideman (1996) "Watershed management: Guidelines for Indian Conditions", Omega Scientific, New Delhi.

Reference Books:

1. Ghanshyam Das (2004) "Hydrology and Soil Conservation Engineering", Prentice-Hall of India Pvt. Limited.
2. Rajvir Singh (2003) "Watershed Planning & Management", Yash Publishing House.
3. DeBarry, Paul A. (2004) "Watersheds - Processes, Assessment and Management", John Wiley & Sons Hoboken, USA.
4. Vijay P. Singh, Donald K. Frevert (2005) "Watershed Models", CRC Press.

Course Outcomes:

1. Explain about concept of watershed
2. Recognize rainfall runoff modelling
3. Develop soil erosion modelling
4. Analyze storm water, flood and drought management modelling
5. Use integrated watershed management

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	1	1							
CO2	3	2	1	1	1							
CO3	2	1			3							
CO4	3	2	1	2	1	3						
CO5	3	2	3	2	1	1	3	1	2	2	2	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	3	2	1	1	1	1	1	0	0	0	0	0

Programme: B.Tech.

Semester: Fifth

Open Elective Course(UOE-I)

Subject Name: Waste Management

(3-0-0) CR-03

Course Content

Module-I

Solid waste – sources and engineering classification, characterization, generation and quantification.

Transport - collection systems, collection equipment, transfer stations, collection route optimization.

Module-II

Solid Waste treatment methods - various methods of refuse processing, recovery, recycle and reuse, composting– aerobic and anaerobic, incineration, pyrolysis and energy recovery,

Disposal methods – Impacts of open dumping, site selection, sanitary land filling – design criteria and design examples, leachate and gas collection systems, leachate treatment.

Module-III

Hazardous Waste Management- Introduction, Sources, Classification, Physico-chemical, Chemical and Biological Treatment of hazardous waste, regulations.

Thermal treatment - Incineration and pyrolysis.

Module-IV

Biomedical Waste management - Definition, sources, classification, collection, segregation Treatment and disposal.

Radioactive waste management - Definition, Sources, Low level and high level radioactive wastes and their management, Radiation standard by ICRP and AERB

Module-V

E- waste management: Waste characteristics, generation, collection, transport and disposal

Soil contamination and site remediation – bioremediation processes, monitoring of disposal sites.

Text Book:

1. Environmental Engineering (Volume II) by S. K. Garg-Khanna Publishers

Reference Books:

1. Environmental Engineering (Volume II) by B. C. Punmia-Khanna Publishers

2. Environmental Engineering by H. S. Peavy, D.R. Rowe and G. Tchobanoglous, MGH.

Course Outcomes:

1. Explain components of solid waste management system.
2. Evaluate recovery, treatment and disposal alternatives for solid waste.
3. Identify the generation and management of hazardous waste.
4. Report biomedical and radioactive waste management.
5. Revise concept of e-waste and soil remediation.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	1	1							
CO2	3	2	1	1	1							
CO3	2	1			3							
CO4	3	2	1	2	1	3						
CO5	3	2	3	2	1	1	3	1	2	2	2	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	3	2	1	1	1	1	1	0	0	0	0	0

6th Semester

Transportation Engineering- I

Course Content

Module-I

Transportation Infrastructure: Modes of transportation – their importance & limitation. Highway Development & Planning in India: Classification of roads and road patterns, Historical Development of road construction, Highway alignment: Requirements, factors controlling alignment & Engineering surveys for Highway alignment.

Module-II

Geometric Design of Highways: Cross-sectional elements, Sight Distances, Horizontal alignments: Horizontal Curves, Super elevation design, Attainment of Super elevation, Radius of horizontal Curve, Extra Widening, Transition Curve and Setback Distance.

Vertical alignments- Gradients, Types and Length of Vertical Curves, Grade Compensation on Horizontal Curve

Module-III

Traffic Engineering: Traffic Studies- Volume studies, Speed Studies, O-D Studies, Capacity Studies and Level of service, Peak hour factor, parking study, accident study and analysis, , Statistical analysis of traffic data, Microscopic and macroscopic parameters of traffic flow,

fundamental relationships, Operations and Traffic Control devices, Signal design by Webster's method. Types of intersections and channelization.

Module-IV

Highway Pavements materials: Aggregate - desirable properties & quality control tests of Aggregates, Bitumen-Types, Source, desirable properties & quality control tests of bitumen.

CBR Test of Soil,

Design of bituminous paving mixes by Marshall Method.

Module-V

Highway Pavement Design: Requirements, types & Design Factors. Design of flexible pavement using IRC: 37, Design of rigid pavements using IRC: 58, Stress analysis, Design of Joints in Rigid Pavement.

Text Books:

Highway Engineering-By Khanna & Justo (Nemchand& Bros., Roorkee (U.A)

Reference Books:

1. Principles & Practice of Highway Engineering – By Dr. L.R. Kadiyalli (Khanna publisher)
2. Relevant IRC codes/ Specifications.

Course Outcomes:

1. Explain current trends in transportation.
2. Employ geometric design of highway system.
3. Revise traffic characteristics and their control.
4. Evaluate highway material characteristics
5. Use the design of Pavements.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	1	1							
CO2	3	2	1	1	1							
CO3	2	1			3							
CO4	2	2	1	2	1	3						
CO5	2	2	3	2	1	1	3	1	2	2	2	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	2	2	1	1	1	1	1	0	0	0	0	1

Steel Structures

Course Content

Module-I

Philosophy, concept and methods of design of steel structures, structural elements, structural steel sections, Bolted Connections, Failure of Bolted Joints, Specifications for Bolted Joints, Analysis and design of bolted connections,

Module-II

Welded connections, Welding Processes and defects, Design of fillet welds, Failure of welds,

Design of tension members

Module-III

Design of compression members, Types of Buckling, Design of axially loaded compression member, Design of Columns Lacing, Design of Column battening, Design of Column Slab base, Design of Column Gusseted base, Design of Moment Resisting base plates, Design of Foundation Bolts.

Module-IV

Design of beams, Lateral stability of beams, Lateral torsional buckling, Bending strength of beams, Shear strength of beams, Web buckling, Web crippling, Design of rolled beams,

Plate girder, Design of plate girder, Plastic section modulus, Design of a Welded plate girder, Design of Gantry girder.

Module-V

Design of Roof trusses, Selection of the type of trusses, Loads and Load combinations in roof trusses, Design procedure, Design of component members in a roof truss.

Text Books:

1. Limit state design of steel structures by S.K. Duggal, Tata McGrawhill 2011

Reference Books:

1. Design of Steel Structures by B.C. Punmia, A.K. Jain and A.K. Jain. Laxmi Publishers.
2. Design of Steel Structures, Vol 1, By Ram Chandra and Virendra Gehlot. Scientific Publishers, Jodhpur.
3. Design of Steel Structures by L.S. Negi, Tata McGraw Hill Book Co.

Course Outcomes:

1. Design different types of connections (bolted & welded) as per Limit state design
2. Determine strength of connections and different rolled steel structural members
3. Map out structural members for tensile loads
4. Distinguish different types of rolled steel structural members for axial and bending load
5. Evaluate built up members and column base

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	3	1	1							
CO2	3	2	1	1	1							
CO3	2	1			3							
CO4	3	2	1	2	1	3						
CO5	3	2	3	2	1	1	3	1	2	2	2	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	3	2	2	1	1	1	1	0	0	0	0	1

Sessional

Design of Hydraulic Structures

Course Content

1. Design of irrigation channels using Kenedy's theory and garret's diagram.
2. Design of irrigation channel using Lacey's theory.
3. Design of vertical drop type canal fall.
4. Design of cross drainage work (aqueduct, super passage)
5. Design of weir.
6. Design of barrage.
7. Design of canal head regulator.
8. Design of earthen dam.
9. Design of gravity dam.
10. Design of ogee spillway

Course Outcomes:

1. Design irrigation channels
2. Explain canal fall, cross drainage work, diversion head work
3. Report stability analysis of gravity dam and seepage analysis of earthen dam with spillway

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	2							2
CO2	1	1	1		1						2	
CO3	2	2	1	1	2	1	1			1		

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	2	2	1	1	2	0	0	0	0	0	1	1

Transportation Engineering Lab

Course Content

1. Test on Soil-CBR Test
2. Tests on Aggregate:(1) Crushing Value Test, (2) Impact Value Test, (3) Los Angeles Abrasion Value Test, (4) Shape Test
3. Tests on Bitumen:(1) Penetration Test, (2) Softening Point Test, (3) Ductility Test, (4) Specific gravity Test
4. Test on Bituminous Mix by Marshall Test.

Course Outcomes:

1. Distinguish subgrade soil.
2. Prepare sample
- 3: Identify coarse aggregate.
- 4: Illustrate bitumen.
- 5: Observe bituminous mix.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	3	3	2		1		1			3
CO2	2	2	3	3	2			2	2	2	1	2
CO3	2	1	3	3	3		1		2			2
CO4	1	1	2	3	2			1	1			3
CO5	1	1	2	2	1	1	2	1	2	1	1	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	1	1	3	3	2	0	1	1	2	1	0	2

Design of Steel Structures

Course Content

1. Types of steel sections and their properties
2. Design and detailing of tension members
3. Design and detailing of compression members
4. Design and detailing of lacing and battening system
5. Design and detailing of slab base and gusseted base
6. Design and detailing of beams and plate girders
7. Design and detailing of roof truss
8. Detailing of framed and bracket connections

Course Outcomes:

1. Design Plate Girder
2. Evaluate Gantry Girder
3. Analyze Roof Truss
4. Formulate Steel Water Tank.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3				2			
CO2	3	3	2	2	1							2
CO3	3	3	2	2	2							
CO4	3	3	3	2	2	2			2			

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	3	3	3	2	2	1	0	0	1	0	0	1

Programme: B.Tech.**Semester: Sixth****Professional Elective Course (UPE-II)****Subject Name: Advanced Concrete Design****(3-0-0) CR-03****Course Content****Module-I**

Introduction to Prestressed Concrete: Prestressing methods, Analysis of prestressing systems, Analysis of beam sections at transfer and service loads, and losses of prestress

Module-II

Computation of earthquake forces on building frame using Seismic Coefficient Method as per IS 1893-2002, Design and detailing of elements of building frame, Moment redistribution, Estimation of wind loads, Desirable features of earthquake resistant construction, Detailing for earthquake resistant construction – ductility criteria

Module-III

Design of Foundations: Design of Raft Foundation, Design of Pile Foundation

Module-IV

Retaining walls: Forces acting on retaining wall, Stability requirement, Design of Cantilever and Counterfort Retaining walls

Module-V

Design of Water tanks: Water tank and staging; Introduction, Design criteria, Design of tanks on ground and underground, Design of rectangular and circular water tank, Design of Intze tank, Staging for overhead tank

Text Books:

1. Advanced Concrete Structure Design by P. C. Verghese, Prentice Hall of India
2. Limit state design- A K Jain, Nem Chand and Brothers
3. Reinforced Concrete (Vol - II) by H. J. Shah, Charotar Publishing House

Reference Books:

1. Limit state design of reinforced concrete by B.C. Punmia, AK Jain and A.K. Jain, Laxmi Publishers New Delhi 2007
2. A K Chopra, Dynamics of Structures: Theory and Applications to Earthquake Engineering, Prentice Hall of India

Course Outcomes:

1. Analyze different Prestressing methods, various systems of the prestressing including calculation of losses.
2. Estimate forces coming to structure due to earthquakes.
3. Design different shallow and deep foundations

4. Explain different retaining structures
5. Report different water tanks

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	3	1	1							
CO2	2	2	1	1	1							
CO3	2	1			3							
CO4	2	2	1	2	1	3						
CO5	2	2	2	2	1	1	2	1	2	2	2	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	2	2	1	1	1	1	0	0	0	0	0	0

Programme: B.Tech.

Semester: Sixth

Professional Elective Course (UPE-II)

Subject Name: Open Channel Flow

(3-0-0) CR-03

Course Content

Module-I

Basic Concepts of Free Surface Flow, classification of flow, velocity & pressure distribution. Conservation laws, continuity equation, momentum equation.

Module-II

Specific energy, Application of momentum & energy equation, Channel transition, Hydraulic jump, Critical flow.

Uniform flow: flow resistance, equation of flow resistance, compound channel, Computation of normal flow depth.

Module-III

Gradually varied flow: Governing equation, classification of water surface profiles, and computation Unsteady Rapidly Varied Flow: Application of conservation laws, Positive and Negative Surges, Moving hydraulic Jump, Spillways, Energy dissipaters, Critical slope and limit slope.

Module-IV

Hydraulics of Mobile bed channel, Initiation of Motion of sediment, Critical analysis of Shield's diagram, Bed forms, and Predication of bed form.

Sediment load: Suspended load, Bed load, total bed material load, measurement and estimation of sediment load.

Module-V

Design of Stable Channels: Regime and Tractive force Methods.

Text Books:

1. Chow, V.T. (1979) "Open Channel Hydraulics", McGraw Hill Publishing Company Ltd., New York.

Reference Books:

2. Henderson, F. M. (1966) "Open Channel Flow", Macmillan, New York.
3. Subramanya, K. (1997) "Flow in Open Channels", Tata McGraw Hill Publishing Company Ltd., New Delhi.
4. R. J. Garde and K. G. Ranga Raju (1977), "Mechanics of sediment transportation and alluvial stream problems" Halsted Press, New York (Wiley Eastern Limited, New Delhi).
5. Chaudhry M.H. (1994), "Open - Channel Flow", Prentice Hall of India, New Delhi.
6. French, R.H. (1986), "Open Channel Hydraulics", McGraw Hill Publishing Company Ltd., New York.
7. Hamill Les (1998), "Bridge Hydraulics", CRC Press Book.

Course Outcomes:

1. Apply continuity, momentum and energy equations to uniform and non-uniform open channel flows
2. Use of specific energy and concept of uniform flow
3. Explain conservation laws to gradually varied and rapidly varied unsteady flows
4. Analyze hydraulics of mobile bed channel
5. Design stable channels

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	1	1							
CO2	3	2	1	1	1							
CO3	2	1			1							
CO4	3	2	1	2	1	1						
CO5	3	2	3	2	1	1	3	1	2	2	2	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	3	2	1	1	1	0	1	0	0	0	0	1

Programme: B.Tech.

Semester: Sixth

Professional Elective Course (UPE-II)

Subject Name: Mechanics of Composite Materials

(3-0-0) CR-03

Course Content

Module-I

Classification and characteristics of Composite Materials, advantages and limitations,

Basic Concepts and characteristics: Homogeneity and Heterogeneity, Isotropy, Orthotropy and Anisotropy;

Module-II

Characteristics and configurations of lamina, laminate, micromechanics and macromechanics, Constituent materials and properties.

Module-III

Elastic behavior of unidirectional lamina, Strength of unidirectional lamina, Macromechanical failure theories: Maximum stress theory, maximum strain theory, Deviatoric strain energy theory (Tsai-Hill), Interactive tensor polynomial theory (Tsai-Wu).

Module-IV

Elastic Behaviour of multidirectional laminates: Basic assumptions, Stress-strain relations, load deformation relations, symmetric and balanced laminates, laminate engineering properties.

Module-V

Bending of laminated plates: Governing equations, Deflection of simply supported rectangular symmetric angle-ply, specially orthotropic, antisymmetric cross-ply laminates.

Text Book:

RM Jones, 'Mechanics of Composite Materials', McGraw-Hill Book Company

IM Daniel and O Ishai, 'Engineering mechanics of composite materials,' Oxford university press

Reference Book:

PK Mallick, 'Fiber-reinforced composites', Marcel Dekker inc

D Hull and TW Clyne, 'An introduction to composite materials', Cambridge University Press

JN Reddy, 'Mechanics of laminated composite plates and shells: theory and analysis', CRC Press.

Course Outcomes:

Reproduce the basic knowledge of mathematics, science and engineering in the areas of Composite materials, classifications and applications.

Explain the mechanical behavior of layered composites compared to isotropic materials.

Apply constitutive equations of composite materials and understand mechanical behavior at micro and macro levels.

Analyze a laminated plate in bending, including finding laminate properties from lamina properties

Use simple laminated structural elements ply-stress and strain, lamina failure theories first ply failure, vibration and buckling analysis.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	1	1							
CO2	3	2	1	1	1							
CO3	2	1			3							
CO4	3	2	1	2	1	3						
CO5	3	2	3	2	1	1	3	1	2	2	2	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
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CO	3	2	1	1	1	1	1	0	0	0	0	0
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Programme: B.Tech.

Semester: Sixth

Professional Elective Course (UPE-II)

Subject Name: Rock Mechanics and Tunnel Engineering

(3-0-0) CR-03

Course Content

Module-I

Introduction, objective, scope and problems of Rock Mechanics, Classification by origin, Lithological, Engineering.

Module-II

Rock exploration, rock coring, geophysical methods. Laboratory testing of rocks, all types of compressive strength, tensile and flexural strength tests,. Strength and failure of rocks, Griffith's theory, Coulombs theory, rheological methods. In-situ tests on rock mass.

Module-III

Mechanical, thermal and electrical properties of rock mass. Correlation between laboratory and field properties. Analysis of stresses.

Module-IV

Thick wall cylinder, formulae, Kreish equation, Green span method. Openings in rock mass and stresses around Pressure tunnels, development of plastic zone. Rock support needed to avoid plastic deformation. Linked and unlinked tunnels. Underground execution and subsidence. Rock mechanics applications.

Module-V

Bearing capacity of homogeneous as well as discontinuous rocks. Support pressure and slip of the joint. Unsupported span of underground openings, pillars. Rock slopes. Rock bolting Tunnels, shapes, usages, Methods of Construction,

Text Book:

- 1.JAEGER and COOK: Fundamentals of Rock Mechanics
2. STAGG K. G. and ZIENKIEWICZ O. C.: Rock Mechanics in Engineering Practice
3. FARMER: Rock Mechanics.

Reference Books:

1. FAIRHURST C.: Design Methods in Rock Mechanics
2. HOSKINS E. R. Jr : Applications of Rock Mechanics
3. HARDY H. R. Jr. New Horizons in Rock Mechanics
4. O'BERT and LEONARD: Rock Mechanics and Design of Structure

Course Outcomes:

1. Explain scope and problems of Rock Mechanics
2. Employ Rock exploration , laboratory testing etc
3. Revise Deformation characteristics of rocks.
4. Evaluate mechanical, thermal and electrical properties of rock mass.
- 5 Report Rock mechanics application, bearing capacity of homogeneous as well as discontinuous rocks, Rock bolting plastic mechanics.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	1	1							
CO2	3	2	1	1	1							
CO3	2	1			3							
CO4	3	2	1	2	1	3						
CO5	3	2	3	2	1	1	3	1	2	2	2	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	3	2	1	1	1	1	1	0	0	0	0	0

Programme: B.Tech.

Semester: Sixth

Professional Elective Course (UPE-II)

Subject Name: Rock Mechanics and Tunnel Engineering

(3-0-0) CR-03

Course Content

Module-I

Introduction, objective, scope and problems of Rock Mechanics, Classification by origin, Lithological, Engineering.

Module-II

Rock exploration, rock coring, geophysical methods. Laboratory testing of rocks, all types of compressive strength, tensile and flexural strength tests,. Strength and failure of rocks, Griffith's theory, Coulombs theory, rheological methods. In-situ tests on rock mass.

Module-III

Mechanical, thermal and electrical properties of rock mass. Correlation between laboratory and field properties. Analysis of stresses.

Module-IV

Thick wall cylinder, formulae, Kreish equation, Green span method. Openings in rock mass and stresses around Pressure tunnels, development of plastic zone. Rock support needed to avoid plastic deformation. Linked and unlinked tunnels. Underground execution and subsidence. Rock mechanics applications.

Module-V

Bearing capacity of homogeneous as well as discontinuous rocks. Support pressure and slip of the joint. Unsupported span of underground openings, pillars. Rock slopes. Rock bolting Tunnels, shapes, usages, Methods of Construction,

Text Book:

1. JAEGER and COOK: Fundamentals of Rock Mechanics
2. STAGG K. G. and ZIENKIEWICZ O. C.: Rock Mechanics in Engineering Practice
3. FARMER: Rock Mechanics.

Reference Books:

1. FAIRHURST C.: Design Methods in Rock Mechanics
2. HOSKINS E. R. Jr : Applications of Rock Mechanics
3. HARDY H. R. Jr. New Horizons in Rock Mechanics
4. O'BERT and LEONARD: Rock Mechanics and Design of Structure

Course Outcomes:

1. Explain scope and problems of Rock Mechanics
2. Employ Rock exploration , laboratory testing etc
3. Revise Deformation characteristics of rocks.
4. Evaluate mechanical, thermal and electrical properties of rock mass.
- 5 Report Rock mechanics application, bearing capacity of homogeneous as well as discontinuous rocks, Rock bolting plastic mechanics.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	1	1							
CO2	3	2	1	1	1							
CO3	2	1			3							
CO4	3	2	1	2	1	3						
CO5	3	2	3	2	1	1	3	1	2	2	2	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	3	2	1	1	1	1	1	0	0	0	0	0

Programme: B.Tech.

Semester: Sixth

Professional Elective Course (UPE-II)

Subject Name: Water Resources Engineering

(3-0-0) CR-03

Course Content

Module-I

Hydrologic cycle, water budget equation, world water balance, history of hydrology and its applications in engineering, sources of data.

Precipitation: Forms of precipitation, weather systems for precipitation, characteristics of precipitation on India, measurement, rain gauge network, preparation and presentation of data, mean aerial precipitation, depth–area-duration curve, intensity-duration-frequency curve, probable maximum precipitation (PMP), design storm.

Module-II

Losses from precipitation: evaporation (process, measurement, empirical equations, analytical methods) evapotranspiration (process, measurements, empirical equations, PET) initial loss (interception, depression storage), infiltration (process, measurement, capacity values, indices).

Stream flow: Measurement of stage, measurement of velocity (current meter and float), direct methods, indirect methods, rating curve and its extrapolation.

Module-III

Runoff: Factors affecting runoff, runoff characteristics of streams, Yield, flow duration curve, flow mass curve and its application, sequent peak algorithm,

Flood: Rational method, empirical formulae, design flood

Module-IV

Hydrograph: Factors affecting hydrograph, components, base flow separation, effective rainfall hyetograph (ERH)

Unit hydrograph: Derivation, derivation of UH of different durations, uses and limitations, distribution graph, synthetic unit hydrograph, instantaneous unit hydrograph

Module-V

Flood-frequency studies: Uses and limitations, Gumbel's method, Log-Pearson Type III distribution, partial duration series, regional flood-frequency analysis, risk, reliability and safety factor.

Flood routing: Basic equations, hydrologic reservoir routing, hydrologic channel routing, hydraulic flood routing method, conceptual methods of flood routing (Clark's method, Nash's model), flood control, flood forecasting.

Text Books:

1. Engineering Hydrology by K. Subramanya. Tata Mc Graw Hill Publication

Reference Books:

1. Elementary Hydrology by V.P. Singh, Prentice Hall Publication
2. Hydrology by P. Jayarami Reddy
3. Handbook of applied hydrology, V.T. Chow, Mc Graw Hill.

Course Outcomes:

1. Develop knowledge on hydrologic cycle and forms of precipitation.
2. Report losses from precipitation and stage and velocity measurement techniques.
3. Explain runoff process and design flood computation.
4. Use flood hydrograph and its application.
5. Employ flood-frequency and flood routing methods.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	3	1	1							
CO2	2	2	1	1	1							
CO3	2	1			3							
CO4	2	2	1	2	1	3						
CO5	2	2	3	2	1	1	3	1	2	2	2	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	2	2	2	1	1	1	1	0	0	0	0	1

Programme: B.Tech.

Semester: Sixth

Professional Elective Course (UPE-III)

Subject Name: Hydraulic Structures

(3-0-0) CR-03

Course Content

Module-I

Irrigation techniques: Definition and necessity, advantages and disadvantages, types, techniques, quality of irrigation water

Water requirement of crops: Crop period and base period, duty and delta, crop seasons, optimum utilization of irrigation water and irrigation efficiencies, consumptive use, effective rainfall, consumptive irrigation requirement, net irrigation requirement, factors affecting consumptive use, estimation of consumptive use, soil moisture irrigation relation, depth and frequency estimation of irrigation

Canal irrigation system: Types of canals, alignment of canals, distribution system, determination of required channel capacity and estimation of channel losses

Module-II

Sediment transport and design of irrigation channels: Sediment load, bed formation, mechanics of sediment transport, design of non-scouring stable channel, stability of channel slopes

Design for irrigation channels: Design procedure (Kenedy's method and Lacey's method), cross-section, balancing depth, fixing of L-section

Lining of irrigation channels: advantages, justification, channel cross-section, permissible velocity, and types of lining (rigid lining and earth type lining)

Module-III

Canal falls: Definition and location, types

Cross drainage works: Types, selection

Diversion head works: Layout, components, weir and barrage

Design of weirs and barrages: Bligh's creep theory, Lane's creep theory, Khosla's theory and concept of flow net, design of weirs and barrages on the basis of Khosla's theory

Module-IV

Regulators and Modules: Canal regulators, canal escapes, canal outlets or modules

Various types of dams: Selection of types of dams and their classification, factors governing selection of a particular dam, selection of dam site

Gravity dams: Definition, typical cross-section, forces acting, modes of failure, criteria for structural stability, stability analysis, design considerations and fixing the section of a dam, design of a dam

Module-V

Earthen dams: Types, methods of construction, causes of failure, design criteria, selection of a suitable preliminary section, seepage analysis, stability of earthen slopes, and seepage control in earthen dam

Spillways: Location, design considerations, types, Energy dissipation below overflow spillways and other types of spillways, stilling basins

Text Books:

Irrigation Engineering and Hydraulic Structures by S.K. Garg, Standard Publishers

Reference Books:

1. Engineering Hydrology by K. Subramanya, Tata McGraw Hill
2. Irrigation Engineering by N.N. Basak, PHI

Course Outcomes:

1. Explain irrigation techniques and water requirement of crops.
2. Develop irrigation channels using sediment transport theory.
3. Report weir and barrages based on seepage theory.
4. Use[- stability criteria of gravity dam and its design.
5. Analyze seepage phenomenon of earthen dam and design of spillway.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	1	1							
CO2	3	2	1	1	1							
CO3	2	1			1							
CO4	3	2	1	2	1	1						
CO5	3	2	3	2	1	1	1	1	2	2	2	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	3	2	1	1	1	0	0	0	0	0	0	0

Programme: B.Tech.

Semester: Sixth

Professional Elective Course (UPE-III)

Subject Name: Water Resources Planning and Management

(3-0-0) CR-03

Course Content

Module-I

Water Resources Planning and Management: An overview: Introduction, Planning and Management Issues, Cause of Planning and Management, Scanty Water, Excessive Water, Polluted Water, Degradation of Aquatic and Riparian Ecosystems, Other Planning and Management Issues, System Components, Planning Scales and Sustainability, Spatial Scales for Planning and Management, Temporal Scales for Planning and Management, Sustainability Planning and Management, Approaches, Top-Down Planning and Management, Bottom-Up Planning and Management, Integrated Water Resources Management, Planning and Management Aspects, Technical Aspects, Economic and Financial Aspects, Institutional Aspects, Analyses for Planning and Management, Models for Impact Prediction and Evaluation Shared-Vision Modelling, Adaptive Integrated Policies, Post-Planning and Management Issues, Meeting the Planning and Management Challenges

Module-II

Water Resource Systems Modelling: Its Role in Planning and Management: Introduction, Modelling of Water Resources Systems, an Example Modelling Approach, Characteristics of Problems to be Modelled, Challenges in Water Resources Systems Modelling, Challenges of Planners and Managers, Challenges of Modelling, Challenges of Applying Models in Practice, Developments in Modelling, Modelling Technology, Decision Support Systems, Shared-Vision Modelling, Open Modelling Systems, Example of a DSS for River Flood Management

Module-III

River Basin Planning Models: Introduction, Scales of River Basin Processes, Model Time Periods, Modelling Approaches for River Basin Management, Modelling the Natural Resources System and Related Infrastructure, Watershed Hydrological Models, Classification of Hydrological Models, Hydrological Processes: Surface Water, Hydrological Processes: Groundwater, Modelling Groundwater: Surface Water Interactions, Stream flow Estimation, Stream flow Routing, Lakes and Reservoirs, Estimating Active Storage Capacity, Reservoir Storage-Yield Functions, Evaporation Losses, Over and Within-Year Reservoir Storage and Yields, Estimation of Active Reservoir Storage Capacities for Specified Yields, Wetlands and Swamps, Water Quality and Ecology, Modelling the Socio-Economic Functions In a River Basin, Withdrawals and Diversions, Domestic, Municipal and Industrial Water Demand, Agricultural Water Demand, Hydroelectric Power Production, Flood Risk Reduction, Reservoir Flood Storage Capacity, Channel Capacity, Lake-Based Recreation, River Basin Analysis, Model Synthesis, Modelling Approach Using Optimization, Modelling Approach Using Simulation, Optimization and/or Simulation, Project Scheduling

Module-IV

Flood Management: Introduction, State-wide flood management, General History, Other Considerations, Flood Frequency and Protection, The various river basins in state-wide, Problems and Solutions, Managing Risk, Storage, Discharge-Increasing Measures, Green Rivers, Use of Existing Water Courses, The Overall Picture, Dealing With Uncertainties, Interactions Among User Groups, Creating a Flood Management Strategy, The Role of the

Government and NGOs, Flood Risk Reduction, Reservoir Flood Storage Capacity, Channel Capacity, Estimating Risk of Levee Failures, Annual Expected Damage From Levee Failure, Risk-Based Analyses, Decision Support and Prediction, Floodplain Modelling, Integrated 1D–2D Modelling

Module-V

Drought Management: Introduction, Drought Impacts, Defining Droughts, Causes of Droughts, Global Patterns, Teleconnections, Climate Change, Land Use, Drought Indices, Percent of Normal Indices, Standardized Precipitation Index, Palmer Drought Severity Index, Crop Moisture Index, Surface Water Supply Index, Reclamation Drought Index, Deciles, Method of Truncation, Water Availability Index, Days of Supply Remaining, Drought Triggers, Virtual Drought Exercises

Text Books:

Loucks, Daniel P., van Beek, Eelco “Water Resource Systems Planning and Management”, Springer publication.

Reference Books:

1. Sarah Luck “Water Resources Management”, Syrawood Publishing House.
2. ZiemiSka-Stolarska Aleksandra ,Zbici Ski Ireneusz , ImbierowiczMiros Aw “Analysis of the System of Management Plans and Water Resources”, LAP Lambert Academic Publishing.y

Course Outcomes:

1. Revise water resources planning and management issues
2. Measure water resources systems
3. Use river basin planning models
4. Report about flood management
5. Explain about drought management

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	1	1							
CO2	3	2	1	1	1							
CO3	2	1			3							
CO4	3	2	1	2	1	1						
CO5	3	2	3	2	1	1	1	1	2	2	2	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	3	2	1	1	1	0	0	0	0	0	0	0

Course Content

Module-I

Theory of vibrations: Basic definitions- free and forced vibrations with and without damping for single degree freedom system- Resonance and its effect – magnification – Logarithmic decrement – Transmissibility

Module-II

Machine Foundations: Types, Design criteria, permissible amplitudes and bearing capacity.

Module-III

Block foundation: Degrees of freedom - analysis under different modes of vibration.

Module-IV

Analysis of Two Degree freedom systems under free and forced vibrations -Principles of Design of Foundations for reciprocating and impact machines as per IS code.

Module-V

Vibration Isolation: Types and methods – Isolating materials and their properties.

Text Book:

- 1.Handbook of Machine Foundations by P.Srinivasulu and G.V.Vaidyanathan, Tata McGraw Hill
2. Soil Dynamics by Shamsheer Prakash

Reference Books:

1. Dynamics of Bases and Foundations by Barken, McGraw Hill Publishing Co.,New York
2. Vibration of Soils and Foundations by Richart, Hall and Woods, Prentice Hall, eaglewood

Course Outcomes:

1. Explain various design parameters for different machines,
- 2 Design block foundation for machines.
- 3 Use different mode of vibration
- 4 Employ various reciprocating and impact machine foundation
- 5 Assess the influence of vibrations and selection of remediation methods based on the nature of vibration.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	1	1							
CO2	3	2	1	1	1							
CO3	2	1			2							
CO4	3	2	1	2	1	2						
CO5	3	2	3	2	1	1	2	1	2	2	2	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	3	2	1	1	1	1	0	0	0	0	0	0

Programme: B.Tech.

Semester
: Sixth

Professional Elective Course (UPE-III)

Subject Name: Urban Drainage and sewerage system

(3-0-0)
CR-03

Course Content

Module-I

Urban Hydrological Cycle, Effects of Urbanization on Catchment Hydrology, Need for Urban Drainage System, Planning Objectives, Interaction of Urban and Surrounding Areas, Approaches to Urban Drainage.

Types of sewerage system: Combined system, Separate System, Partially separate system, Patterns of Collection System, Components of sewerage system, design and planning of sewerage systems.

Module-II

Quantity estimation of Sewage: Sources of Sanitary Sewage, Dry Weather Flow, Evaluation of Sewage Discharge, Design Period, Design Discharge, Population forecasting

Module-III

Quantity Estimation of Storm Water: Factors Affecting the Quantity of Storm water, Storm hyetographs – Rainfall excess calculations, time of concentration, Methods for Estimation of Quantity of Storm Water

Module-IV

Hydraulic Design of Sewers and Storm Water Drains: Difference Between Water Supply Pipes and Sewer Pipes, Requirements of Design and Planning of Sewerage System, Hydraulic Formulae for Determining Flow Velocities, Minimum and maximum Velocity, Hydraulic characteristics of circular sewer running full or partially full

Design of Storm Water Drains for Separate System: Important points for design.

Module-V

Sewer materials, Laying of Sewer Pipes, Hydraulic Testing of Sewers.

Sewer Appurtenances: Manholes, Drop manholes, Lamp holes, Clean-outs, Street inlets, Catch basins, Flushing Tanks, Grease & Oil traps, Inverted Siphons, and Storm Regulators

Maintenance, cleaning and ventilation of Sewers

Sewage and Storm water Pumping Stations: Types of Pumps, Pumping System Design, Types of Pumping Stations

Text Book:

1. Environmental Engineering (Volume II) by S. K. Garg-Khanna Publishers

Reference Books:

1. Hall M.J. (1984), "Urban Hydrology", Elsevier Applied Science Publishers
2. Geiger, W.F. Marsalek, J.Zudima and Rawls, G.J. (1987 "Manual on Drainage in Urban Areas", 2 Volumes, UNESCO, Paris.)
3. Geiger, W.F. and Jayakumar, K.V. (Ed.) (1996) "Lecture Notes of the V International Course on Urban Drainage in Developing Countries", Regional Engineering Collage, Warangal.
4. Wanielista, M.P. and Yousef, Y.A. (1993), "Stormwater Management", John Wiley and Sons, Inc., New York.

Course Outcomes:

1. Explain urban hydrological cycle and sewerage system.
2. Estimate sewage generation and study different aspects of it.
3. Evaluate storm water generation and study different aspects of it.
4. Relate knowledge of design of sewers and storm water drains.

5. Report components of urban drainage and sewerage system.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	1	1							
CO2	3	2	1	1	1							
CO3	2	1			3							
CO4	3	2	1	2	1	3						
CO5	3	2	3	2	1	1	1	1	2	2	2	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO12
CO	3	2	1	1	1	1	0	0	0	0	0	

Programme: B.Tech.

Semester: Sixth

Open Elective Course (UOE-II)

Subject Name: Project Management

(3-0-0) CR -03

Course Content

Module-I

Characteristics of projects, Definition and objectives of Project Management, Stages of Project Management, Project Planning Process, Establishing Project organization. Work definition: Defining work content, Time Estimation Method, Project Cost Estimation and budgeting, Project Risk Management..

Module-II

Project scheduling and Planning Tools: Work Breakdown structure, LRC, Gantt charts, CPM/PERT Networks. Developing Project Plan (Baseline), Project cash flow analysis, Project scheduling with resource Constraints: Resource Leveling and Resource Allocation.

Module-III

Specific methodologies for planning: Critical Path Method (CPM); Precedence Diagramming Method (PDM); Program Evaluation and Review Technique (PERT); Graphical Evaluation and Review Technique (GERT); Queue - Graphical Evaluation and Review Technique (GERT); Simulation Language for Alternative Modelling (SLAM); Dynamic Planning and Control Methodology (DPM); Critical Chain Planning; Resource Loading.

Module-IV

Time Cost Tradeoff: Crashing Heuristic. Project Implementation: Project Monitoring and Control with PERT/Cost, Contract Management, Project Procurement Management; Post Project Analysis. life-cycle and post-mortem analysis.

Module-V

Computers applications in Project Management, Such as Microsoft® Project, Primavera Project Planner®, Primavera® Monte Carlo, Crystal Ball® and Pro Chain are available to the project manager for deterministic and probabilistic planning. In this course we will use the following:

Primavera® P3 — for deterministic time and resource scheduling; Primavera® Monte Carlo — for probabilistic time and resource scheduling; Primavera® Expedition — for documenting multiple and complex projects; Pro Chain® — for scheduling with the critical chain method; Crystal Ball® — for risk analysis; Vensim® — for system dynamics analysis

Text Book:

1. Shtub, Bard and Globerson, Project Management: Engineering, Technology, and Implementation, PH Inc.
2. Lock, Gower, Project Management Handbook.

Reference Books:

1. Cleland and King, VNR Project Management Handbook.
2. Wiest and Levy, Management guide to PERT/CPM, PHI.
3. Horald Kerzner, Project Management: A Systemic Approach to Planning, Scheduling and Controlling, CBS Publishers, 2002.
4. S. Choudhury, Project Scheduling and Monitoring in Practice.
5. P. K. Joy, Total Project Management: The Indian Context, Macmillan India Ltd.

Course Outcomes:

1. Explain basic concepts of project management
2. Revise Project scheduling and Planning Tools
3. Plan a project using CPM and PERT techniques
4. Evaluate Time Cost Tradeoff
5. Use computer tools for project management

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	1	1							
CO2	2	2	1	1	1							
CO3	2	1			3							
CO4	3	2	1	2	1	3						
CO5	3	2	3	2	1	1	3	1	2	2	2	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	2	2	1	1	1	1	1	0	0	0	0	1

Programme: B.Tech.

Semester: Sixth

Open Elective Course (UOE-II)

Course Content**Module-I**

Elements of City plan, Surveys, Zoning, Housing, Slums, Parks & Play grounds, Public buildings & Town centres and Industries

Module-II

Communication & Traffic Control, Urban renewal & replanning the existing towns, Master plan, Planning law & Legislation.

Module-III

Architecture as a fine art, its aim, importance and methods of study. Fundamental principles of architecture- Truth, beauty and Goodness. Qualities and factors of beauty. Qualities : Strength, Vitability, Restraint, Refinement, Repose, Grace, Breadth, Scale, Expression or setting out of purpose, Unity in concept, Factors : Mass, Form, Proportion, Balance, Symmetry, Solids, and voids, Light and shade.

Module-IV

Influence on architectural development : Effects of topography, Climate, Religion, Customs, Traditions, Technological development and aspirations of time. Class in Orders : Definition, Doric, Ionic, Corinthian, Composite and Tuscan orders, Knowledge of the details of their parts and proportions.

Module-V

Indian Architecture : Stupas, Chaityas and Viharas with examples. Jain style - Architectural character and example . Hindu style – Dravidian temples and gopuram, Ori ssan group of temples with examples, Indo- Islamic architecture with examples. Architectural character of modern architecture.

Text Books:

Fundamentals of town planning -G.K. Hiraskar - Dhanpat Rai & Publication

Reference Books:

1. Architects & Builders hand book – Kiddar& Parker
2. The great ages of world architecture - G.K.Hiraska

Course Outcomes:

1. Explain the functional role of elements for their judicious allocation in master plan.
2. Revise Planning law & Legislation
3. Relate the trend in Indian architecture.
4. Report architectural development.
5. Use modern architecture.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	1	1							
CO2	3	2	1	1	1							
CO3	2	1			3							
CO4	3	2	1	2	1	1						
CO5	3	2	3	2	1	1	3	1	2	2	2	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	3	2	1	1	1	0	1	0	0	0	0	0

Programme: B.Tech.**Semester: Sixth****Open Elective Course (UOE-II)****Subject Name: Ground Improvement Technique****(3-0-0) CR-03****Course Content****Module-I**

Introduction: situations where ground improvement becomes necessary

Module-II

Mechanical modification: dynamic compaction, impact loading, compaction by blasting, vibro-compaction; pre-compression, stone columns; Hydraulic modification: dewatering systems, preloading and vertical drains, electro-kinetic dewatering

Module-III

Chemical modification; modification by admixtures, stabilization using industrial wastes, grouting

Module-IV

Thermal modification: ground freezing and thawing

Module-V

Soil reinforcement and Application of soil reinforcement: Reinforced earth, basic mechanism, type of reinforcements, selection of stabilization/improvement of ground using Geotextiles, Geogrid, geomembranes, geocells, geonets, and soil nails. shallow foundations on reinforced earth, design of reinforced earth retaining walls, reinforced earth embankments structures, wall with reinforced backfill, analysis and design of shallow foundations on reinforced earth, road designs with geosynthetics.

Reference Books:

1. Hausmann, M.R., Engineering Principles of Ground Modification, McGraw-Hill
2. International Editions, 1990.
3. Yonekura, R., Terashi, M. and Shibazaki, M. (Eds.), Grouting and Deep Mixing, A.A.
4. Balkema, 1966.
5. Moseley, M.P., Ground Improvement, Blackie Academic & Professional, 1993.
6. Xanthakos, P.P., Abramson, L.W. and Bruce, D.A., Ground Control and Improvement,
7. John Wiley & Sons, 1994.
8. Koerner, R. M., Designing with Geosynthetics, Prentice Hall Inc. 1998.
9. Shukla, S.K., Yin, Jian-Hua, "Fundamentals of Geosynthetic Engineering", Taylor & Francis.

Course Outcomes:

1. Explain the necessity of ground modification that can be done depending upon the site condition, type and purpose of structure to be constructed.
2. Apply the appropriate ground improvement technique.
3. Employ waste materials in the field.
4. Report about thermal modification.
5. Design geo-synthetics and geo-cells in construction work.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	1	1							
CO2	3	2	1	1	1							
CO3	2	1			3							
CO4	3	2	1	2	1	1						
CO5	3	2	3	2	1	1	1	1	2	2	2	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	3	2	1	1	1	0	0	0	0	0	0	0

7th Semester

Structural Analysis – II

Course Content

Module-I

Introduction to Force and Displacement methods of structural analysis, Analysis of continuous beam and plane frame by slope deflection method and moment distribution method.

Module-II

Two hinged arches and analysis of suspension cable with two hinged stiffening girders

Module-III

Influence lines for indeterminate beams, influence lines for two hinged arches and stiffening girders.

Module-IV

Plastic Analysis: Plastic modulus, shear factor, plastic moment of resistance, load factor, Simple cases of beams and frames (continuous beam and simple rectangular portals), Application of upper and lower bound theorems

Module-V

Matrix method of analysis: flexibility and stiffness method, Application to simple trusses and beams: FLEXIBILITY METHOD: Equilibrium and compatibility – Determinate vs Indeterminate structures – Indeterminacy – Primary structure – Compatibility conditions – Analysis of indeterminate pin-jointed plane frames, continuous beams, rigid jointed plane frames.

STIFFNESS MATRIX METHOD: Element and global stiffness matrices – Analysis of continuous beams – Co-ordinate transformations – Transformations of stiffness matrices, load vectors and displacements vectors – Analysis of pin-jointed plane frames and rigid frames

Text Book:

1. Indeterminate Structures by C.K. Wang.
2. Matrix methods of Structural Analysis By Pandit and Gupta

Reference Books:

1. Indeterminate Structures by J.S. Kenney

Course Outcomes:

1. Explain the force and displacement methods of structural analysis and the use of slope deflection method and moment distribution method of analysis of indeterminate structures
2. Analyze the indeterminate structures by Kani's method and the methods for analysis of two hinged arches, cables with stiffening girders
3. Use the methods for analysis of indeterminate structures due to rolling or moving loads and their maximum influence on indeterminate beams, two hinged arches, cables with stiffening girders
4. Report plastic analysis of structures
5. Apply the basic concepts of flexibility and stiffness matrix methods in structural analysis

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	1	1							
CO2	2	2	1	1	1							
CO3	2	1			3							
CO4	3	2	1	2	1	3						
CO5	3	2	3	2	1	1	3	1	2	2	2	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	2	2	1	1	1	1	1	0	0	0	0	1

Transportation Engineering II

Course Content

Module-I

History of Indian Railways, Railway track & Component- Permanent Way, Gauge, Track Structure, rails, rail joints, Wear and other defects in rail, creep of rail, Coning of wheels

Sleepers- Function, Requirements and Classification, Sleeper Density. Ballast- Function, Requirements, Different materials used for ballast, Depth of ballast Cushion.

Module-II

Traction, tractive effort and hauling capacity. Geometric design- Alignment, horizontal curves, super elevation, equilibrium cant and cant deficiency, Gradients and grade compensation, vertical curves. Point and Crossing-Turnout, Design of simple turn out, Crossing, various types of track junction and their configurations.

Module-III

Signalling and interlocking: Objective and Classification, Control. Interlocking- Purpose, Principle and Methods. Train Control System.

Module-IV

Air Transport Development: Aircraft characteristics, Airport site selection, Imaginary surfaces.

Airport components: orientation and configuration, Basic runway length and corrections, Taxiway and Exit taxiway, holding aprons. Hangar, Terminal building.

Module-V

Visual Aids and Air Traffic Control: Airport making and lighting, Instrumental landing systems and Air navigation aids.

Bridge Engineering: Terminology, Types and Site Selection.

Text Books:

1. A Text Book of Railway Engineering by S C Saxena and S P Arora, Dhanpat Rai & Sons
2. Airport Planning & design by S. K. Khanna, M.G. Arora & S. S. Jain- Nemchand& Bros.
3. Bridge Engineering – By S.P. Bindra (Dhanpat Rai publication)

Reference Books:

1. Railway Engineering, M.M. Agrawal, Prabha& Co., New Delhi

2. Railway Track Engineering by J. S. Mundrey, Tata McGraw Hill Book Co.
3. Bridge Engineering-By D.J. Victor

Course Outcomes:

1. Explain the Railway track components.
2. Use the Geometric Elements.
3. Design Railway Turnout and signals.
4. Employ feasible airport site, design of runway and taxiway and suitable air traffic control system.
5. Select feasible bridge site

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	1	1							
CO2	3	2	1	1	1							
CO3	2	1			2							
CO4	3	2	1	2	1	2						
CO5	3	2	3	2	1	1	3	1	2	2	2	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	3	2	1	1	1	1	1	0	0	0	0	1

Sessional

Transportation and Geotechnical Design

Course Content

1. Design of earthen slope
2. Landfill Design
3. Design of retaining walls and sheet piles
4. Design of shallow foundation
5. Design of deep foundation
6. Design of machine foundation
7. Geometrical design of Highway
8. Design of flexible and rigid pavements by IRC method
9. Orientation and geometrical design of Runway.
10. Turn out design.

11. Earthwork calculation.

Course Outcomes:

- 1: Use of stability analysis of slopes, pressure distribution diagram and bearing capacity of shallow foundation.
- 2: Design and analyse highway geometric elements & ability to design pavement.
- 3: Calculate cost of earthwork.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	3	1	2							
CO2	2	2	1	2					1			2
CO3	2	1	1	1	1	1	2	1	2	2	2	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	2	1	2	1	1	0	1	0	1	1	1	1

Programme: B.Tech.

Semester: Seventh

Professional Elective Course (UPE-IV)

Subject Name: Estimation and Professional Practice

(3-0-0) CR-03

Course Content

Module-I

Introduction to estimation and specification: General introduction to quantity surveying: purpose of estimation; Types of estimates, various items to be included in estimates; Principles in selecting units of measurement for items, various units and modes of measurement for different trades, I.S. 1200. Specification: purpose and basic principles of general and detailed specifications; detailed specifications for various items of work.

Module-II

Reading and interpretation of architectural and structural drawings: Taking out quantity, Measurement and abstract sheets and recording; detailed estimate of buildings, Preparation of schedule for steel as reinforcement. Approximate estimates: purpose, various methods used for buildings. Preparation of bills of quantities

Module-III

Analysis of rates: factors affecting the cost of materials, labour; Task work, schedule as basis of labour costs; Plants and equipment: hour costs based on total costs and outputs. Transports, octroi; Overhead charges, rates for various items of construction of civil engineering works; Standard schedule of rate, price escalation

Module-IV

Contracts management: Legal aspects, Types of construction contracts; Tenders: tender form, submission and opening of tenders, measurement book, muster roll, piecework agreement and

work order.

Disputes: Causes, types of dispute resolution mechanisms, dispute resolution by arbitration: advantages, procedure.

Construction laws: related to land acquisition, labour safety and welfare.

Module-V

Introduction to valuation: Definition of value, price and cost; purpose of valuation and its function; Principles of valuation, Valuer and his duties; Attributes of value; Different types of values: Book value, salvage value, scrap value, replacement value, reproduction value, earning value, Market value, Potential value, Distress value, Speculation value, Sentimental value, Accommodation value. Essential characteristics of market value; Factors affecting the valuation of properties-tangible and intangible properties, Landed properties- free hold and leasehold properties, different types of lease

Reference Books:

1. Estimating and costing in Civil Engineering Theory & Practice, B.N.Dutta,
2. Estimating, Costing, Specification and Valuation on Civil Engineering, by M. Chakraborti
3. Construction Management and Planning, B. Sengupta & H Guha, Tata McGraw Hill

Course Outcomes:

1. Explain fundamentals of estimation and specifications
2. Interpret structural drawing and quantity estimation
3. Analyze rates of various items of work
4. Report concepts of contract and laws.
5. Revise fundamentals of civil engineering valuation

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	1	1							
CO2	3	2	1	1	1							
CO3	2	1			3							
CO4	3	2	1	2	1	3						
CO5	3	2	1	2	1	1	3	1	2	2	2	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	3	2	1	1	1	1	1	0	0	0	0	0

Programme: B.Tech.

Semester: Seventh

Professional Elective Course (UPE-IV)

Subject Name: Economic Evaluation and Analysis of Transport Projects

(3-0-0) CR-03

Course Content

Module-I

Project Formulation: Project Preparation – Flow Chart for Project preparation. Project Cycle-Project Formulation – Need and Scope of Project Formulation - Various Aspects and Approaches in Project Formulation. Stages in Project Formulation. Preparation of Feasibility Report and DPR – Guidelines.

Module-II

Economic Evaluation: Need for Economic Evaluation; Stages involved in Economic Analysis; Cost and Benefit components; Discounting Criteria; Welfare economics; Social costs; Rate of Return; Road User Cost study in India ; Value of Travel time Savings - Economic concept of evaluation of travel time savings; Issues connected with evaluation of travel time savings. Vehicle operating costs - Components of VOC, Accident costs; Methodologies for economic evaluation of an accident.

Module-III

Economic Analysis; Basic Concepts of Economic Analysis, Principles of Economic Analysis; Cash flow diagrams; Time value of Money; Development of cash flow Diagrams

Module-IV

Methods of Economic Evaluation -Equivalent Uniform Annual Cost Method; Present worth of cost method;- Equivalent uniform annual net return method; Net present value method; Benefit cost ratio method; Rate of Return Method. Applications of these methods to highway projects.

Module-V

Project appraisal by shadow pricing with case studies; Toll system analysis, Financial analysis; Budgeting.

Text Books:

1. Traffic Engineering and Transport Planning - L.R Kadiyali, Khanna Publishers.
2. Transportation Engineering Economics - Heggie. I. G.; Mc Graw Hill Publishers.

Reference Books:

1. IRC: SP: 19; 2001, Manual For Survey, Investigation & Preparation of Road Projects.
2. IRC:SP: 30, Manual on Economic Evaluation of Highway Projects in India.
3. Economic Analysis for Highways - Winfrey.R; International TextBook Company.
4. Road User Cost Study, CRRI
5. Road Project Appraisal, for Developing Countries, J.W.Dickey ,John Wiley & Sons. 59

Course Outcomes:

1. Assess the financial feasibility of the project.
2. Analyze the impact on cash flow and revenue streams.
3. Explain the impact analysis – long-term impact of project on tax revenues
4. Use Economic Evaluation methods
5. Report Budgeting.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	1	2							
CO2	3	2	1	2	1							

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	3	2	1	1	2	1	1	0	0	0	0	1

Programme: B.Tech.

Semester: Seventh

Professional Elective Course (UPE-IV)

Subject Name: Computational Fluid Dynamics

(3-0-0) CR-03

Course Content

Module-I

Computational Fluid Dynamics: Introduction, What, When, and Why? CFD Applications, Numerical vs Analytical vs Experimental, Modeling vs Experimentation

Classification of Partial Differential Equations and Physical Behavior: Mathematical classification of Partial Differential Equation, Illustrative examples of elliptic, parabolic and hyperbolic equations, Physical examples of elliptic, parabolic and hyperbolic partial differential equations.

Module-II

Approximate Solutions of Differential Equations: Error Minimization Principles, Functional involving higher order derivatives, Approximate solution of differential equations through variational formulation, Boundary conditions in the variational form: Primary and secondary variables, Essential and natural boundary conditions, Approximate solutions of differential equations, Properties of variational form, Weighted residual approach: trial function and weighting function, Requirement of trial function and weighting function, Least square method, Point Collocation method, Galerkin's method, Rayleigh-Ritz method.

Module-III

Finite Volume Method: Some Conceptual Basics and Illustrations through 1-D Steady State Diffusion Problems: Physical consistency, Overall balance, FV Discretization of a 1-D steady state diffusion type problem, Composite material with position dependent thermal conductivity, Four basic rules for FV Discretization of 1-D steady state diffusion type problem, Source term linearization, Implementation of boundary conditions.

Module-IV

Discretization of Convection-Diffusion Equations: A Finite Volume Approach: Finite volume discretization of convection-diffusion problem: Central difference scheme, Upwind scheme, Exponential scheme and Hybrid scheme, Power law scheme, Generalized convection-diffusion formulation, Finite volume discretization of two-dimensional convection-diffusion problem, The concept of false diffusion, QUICK scheme.

Module-V

Introduction to Turbulence Modeling: Important features of turbulent flow, Vorticity transport

equation, Statistical representation of turbulent flows: Homogeneous turbulence and isotropic turbulence, General Properties of turbulent quantities, Reynolds average Navier-Stokes (RANS) equation, Closure problem in turbulence: Necessity of turbulence modeling, Different types of turbulence model: Eddy viscosity 2 models, Mixing length model, Turbulent kinetic energy and dissipation, The κ - ϵ model, Advantages and disadvantages of κ - ϵ model, More two-equation models: RNG κ - ϵ model and κ - ω model, Reynolds stress model (RSM), Large eddy Simulation (LES), Direct numerical simulation (DNS).

Reference Books:

1. S.V.Patankar, “Numerical Heat Transfer and Fluid Flow”, McGraw-Hill.
2. T. J. Chung, “Computational Fluid Dynamics”, Cambridge University Press.
3. H.K.Versteeg& W. Malalasekera, “An Introduction to Computational Fluid Dynamics”, Longman Scientific & Technical.
4. J. H. Ferziger and M.Peric, “Computational Methods for Fluid Dynamics”, Springer.
5. John C. Tannehill, Dale A. Anderson and Richard H. Pletcher, “Computational Fluid Mechanics and Heat Transfer”, Taylor & Francis.
6. John D. Anderson Jr, “Computational Fluid Dynamics”, McGraw Hill Book Company.
7. J. Blazek, “Computational Fluid Dynamics: Principles and Applications”, Elsevier.

Course Outcomes:

- 1) Explain basics of Computational Fluid Dynamics and application of Partial Differential Equations
- 2) Use approximate solutions of Partial Differential Equations
- 3) Report fundamentals of finite volume method
- 4) Revise Convection-Diffusion Equations using Finite Volume Method
- 5) Develop different methods in turbulence modelling

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	1	1							
CO2	3	2	1	1	1							
CO3	2	1			3							
CO4	3	2	1	2	1	2						
CO5	3	2	3	2	1	1	3	1	2	2	2	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	3	2	1	1	1	1	1	0	0	0	0	0

Professional Elective Course (UPE-IV)

Subject Name: Structural Design of Water and Sewerage System

(3-0-0) CR-03

Course Content

Module-I

Elements of Water supply and sewerage treatment system: Intake structures; pipe materials; treatment system: aeration, coagulation, flocculation, sedimentation, filtration systems. Design principles.

Module-II

Structural design of pipes: Design of concrete; pre-stressed concrete, steel, cast iron piping mains; sewerage tanks design; anchorage for pipes, massive outfalls, structural design and laying, manufacturing of pipes.

Module-III

Design of concrete roofing systems: Cylindrical, Spherical, Conical shapes using membrane theory and design of various types of folded plates for roofing with concrete.

Module-IV

Analysis and design of water tanks: IS Codes for the design of water retaining structures; Design of circular, rectangular, spherical and Intze type of tanks using concrete.; Design of pre-stressed concrete cylindrical tanks.

Module-V

Analysis and design of water supply elements: Underground reservoirs and swimming pools; Intake towers; Structural design including foundation of water retaining structures such as settling tanks clarifloculators; aeration tanks etc.; effect of earth pressure and uplift considerations; selection of materials of construction.

Course Outcomes:

1. Explain various elements of water supply and sewerage treatment system
2. Analyze and design pipes
3. Employ concrete roofing system for water storage system
4. Design water tanks
5. Revise analysis and design of water supply elements, intake towers, clarifloculators etc.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	1	1							
CO2	3	2	1	1	1							
CO3	2	1			2							
CO4	3	2	1	2	1	2						
CO5	3	2	3	2	1	1	3	1	2	2	2	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	3	2	1	1	1	1	1	0	0	0	0	1

Programme: B.Tech.

Semester: Seventh

Professional Elective Course (UPE-IV)

Subject Name: Bridge Engineering

(3-0-0) CR-03

Course Content

Module-I

Introduction: classification and components of a standard bridge, Engineering and aesthetic requirements, introduction to bridge codes.

Investigation for bridge: Site selection, data drawing, design discharge linear water way, economical span, location of piers and abutments, vertical clearance above HFL, scour depth and choice of bridge type.

Standard Loadings for Road Bridges: Dead load, Live loads, Impact effect, Wind load, Longitudinal forces, Centrifugal forces, Horizontal forces due to water current, Buoyancy effect, Earth pressure, Deformation stresses, Erection stresses, Temperature effects, and Seismic force.

Module-II

Foundation and substructures: Types of foundation (open, pile, well and caisson), design of piers, abutments, wing wall and bed blocks.

Module-III

Design of Culverts: Design of Pipe culverts (hydraulics and structural), Analysis and design of right, skew and curved slab culvert; design of single vent rectangular box culvert.

Module-IV

Design of Girders: Design and detailing T-beam bridge (without footpath), load distribution, design and orthographic plate analysis of bridge deck.

Bearings: Bearings for slab bridges and girder bridges, design of elastomeric bearing.

Joints: Design and construction of expansion joints.

Module-V

Introduction to long span bridges: Cantilever bridges, Arch bridges, Cable stayed bridges, suspension bridges, Pre-stressed concrete bridge (pre-tensioned and post-tensioned) and steel bridges.

Bridge Launching: Methods of erection of concrete, steel, pre-stressed and composite bridges

Inspection and Maintenance of Bridges: Types of inspection (routine inspection, principal inspection and special inspection), Types of maintenance (Ordinary maintenance and specialized maintenance).

Text Books:

Essentials of Bridge Engineering, by DJ Victor, Oxford IBH.

Reference Books:

Design of Bridge Structures, by T. R. Jagadeesh, PHI.

Principles and Practice of Bridge Engineering, SP Bindra, Dhanpat Rai Publications

Course Outcomes:

1. Explain fundamental concepts and loadings for design of bridge and culverts
2. Design bridge foundation
3. Analyze and design road culverts
4. Report design of bridge girders and bearings
5. Use the procedures for bridge launching and inspection and maintenance of bridges.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	3	1	1							
CO2	2	2	1	1	1							
CO3	2	1			2							
CO4	3	2	1	2	1	3						
CO5	2	2	3	2	1	1	3	1	2	2	2	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	2	2	2	1	1	1	1	0	0	0	0	1

Programme: B.Tech.

Semester: Seventh

Open Elective Course (UOE-III)

Subject Name: Green building

(3-0-0) CR-03

Course Content**Module-I****GREEN BUILDING PROCESS AND ECOLOGICAL DESIGN**

Fundamental Principles of Green Building, Introduction to high-performance green buildings, Conventional versus green building delivery systems - Design and construction relationships - Green building project execution - the integrated design process - green building documentation requirements - design versus ecological design - historical perspective - contemporary ecological design - future ecological design - green design to regenerative design.

Module-II

GREEN BUILDING SYSTEMS Sustainable sites Design and landscaping – enhancing ecosystems - building envelop – selection of green materials - products and practices - passive design strategy – internal load reduction – indoor environment quality strategies - Building energy system strategies – Water cycle strategies- building water and waste management – relevance to LEED / IGBC standards.

Module-III**GREEN BUILDING IMPLEMENTATION**

Site protection planning - health and safety planning - construction and demolition waste management - reducing the footprint of construction operations - maximizing the value of building

commissioning in HVAC System, lighting and non mechanical Systems - costs and benefits relevance to LEED / IGBC standards.

Module-IV

ASSESSMENT TECHNIQUES

Methods and tools for building assessment- USGBC LEED building assessment standard - LEED certification process – Green Globes building assessment protocol- international building assessment systems - LEED-NC Platinum / gold / silver building case studies – trends in building rating systems – IGBC standards – ECBC compliances. Florida Green Building Coalition.

Module-V

GREEN BUILDING ECONOMICS

Future directions in green high performance building technologies- Carbon accounting-Green Building specifications. Business case for high-performance green buildings - the economics of green building - benefits - managing initial costs - cost barrier in project management – long term environment benefits.

Text Book:

Reference Books:

1. Jerry Yudelson, Green Building through Integrated Design, McGraw Hill, 2008
2. Alex Wilson and Mark Peipkorn., Green Building Products: theGreenSpec guide to residential building materials, 2nd Edition, Gabriola Island, BC:
3. Jane Anderson, David E. Shiers, and Mike Sinclair. The green guide to specification: an environmental profiling system for building materials and components, 3rd Edition, Oxford; Malden, MA: Blackwell Science, 2002.
4. Charles J. Kibert, Sustainable Construction: Green Building Design and Delivery, 2nd Edition, Wiley, 2007.
5. ECBC 2007 Manual, Bureau of Energy Efficiency, New Delhi

Course Outcomes:

1. Explain concept and process for design of green buildings
2. Revise green building systems
3. Evaluate construction methods.
4. Assess green buildings
5. Distinguish cost-benefits of retrofitting, remodeling, or renovating existing homes

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	3	1	1							
CO2	3	2	1	1	1							
CO3	2	1			3							
CO4	3	2	1	2	1	2						
CO5	3	2	2	2	1	1	3	1	2	2	2	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	3	2	1	1	1	1	1	0	0	0	0	0

Programme: B.Tech.

Semester: Seventh

Open Elective Course(UOE-III)

Subject Name: Water Power Engineering

(3-0-0) CR-03

Course Content

Module-I

Hydroelectric Power: Introduction, essential stream flow data for hydro- power studies, storage and pondage

Module-II

Essential stream flow data for water power studies, Flow duration curve, Flow mass curve

Module-III

Classification of hydro-power plants, principal components of a hydro-power plant, important terms and definitions connected with hydro-power

Module-IV

Primary and secondary power, load factor, utilization factor and capacity factor, assessment of available power

Module-V

Thermal power and hydropower, comparison of hydro power with thermal power costs with reference to Indian conditions, typical hydro-electric power developments in India, hydro-power potentials in India and the World

Text Books:

S.K. Garg “Irrigation Engineering & Hydraulic Structures”, 19th Edition, Khanna Publishers.

P. N. Modi, S. M. Seth (2002) “Hydraulics And Fluid Mechanics Including Hydraulics Machines”, Standard Book House.

Course Outcomes:

1. Explain about hydroelectric power generation
2. Analyze stream flow data for water power studies
3. Design different components of hydropower plant
4. Report primary and secondary power
5. Differentiate between thermal power and hydro power

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	1	1							
CO2	3	2	1	1	1							

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	3	2	1	1	1	1	1	0	0	0	0	0

Programme: B.Tech.

Semester: Eighth

Professional Elective Course (UPE-V)

Subject Name: Construction Management

(3-0-0) CR-03

Course Content

Module-I

Types of construction projects, Objectives and functions of construction management. Project Management: Project Planning, Scheduling and Controlling, Bar charts: Development of Bar charts and its shortcomings. Network techniques: Event, activity, Dummy activity. Network rules, Numbering of events. Critical Path Method, Critical activities, Slack. Project Evaluation and Review Techniques (PERT): Time estimates, Different types of Float of activity. Probability of meeting schedule date for the project

Module-II

Cost Model: Project cost, indirect and direct cost, slope of direct cost curve, optimum project duration, contracting the network for cost optimization. Introduction to updating, resources smoothing and resources levelling

Module-III

Construction equipments: Different types of construction equipments, earth moving, dewatering and pumping, grouting, pile driving equipments. Conveyors, cranes, concrete mixture, vibrators, Rollers, Compactors and other road construction equipments. Factors affecting selection of construction equipments. Safety and safety measures in construction works. Quality control

Module-IV

Introduction to optimization. Linear system: graphical method, simplex method. Sensitive analysis. Dynamic programming.

Module-V

Inventory management: Functional role of Inventory, factors involved in inventory problem
Deterministic Inventory control model: single and multiple item inventory control model with and without shortage.

Equipment management: Replacement and maintenance model. Owning and hiring cost, depreciation. Work motion study. Multiple activity chart.

Text Books:

1. Construction planning, Equipments and Methods, R. L.Peurify. Tata McGraw Hill
2. Construction Management and Planning, B Sengupta& H Guha, Tata McGraw Hill
3. Construction Planning and Management, Mahesh Verma
4. PERT & CPM, L. S. Sreenath. East - West Press.
5. Optimization, S.S. Rao, Tata Mc Graw Hill

Course Outcomes:

1. Identify different aspects of project management
2. Evaluate the cost and time of a Project by using CPM & PERT Techniques
3. Report resources in a project
4. Describe material procurement method and control for a project
5. Select the suitable equipments and materials required for the execution of a project and to solve optimization problem

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	1	1							
CO2	3	2	1	1	1							
CO3	2	1			3							
CO4	3	2	1	2	1	2						
CO5	3	2	3	2	1	1	2	1	2	2	2	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	3	2	1	1	1	1	0	0	0	0	0	0

Programme: B.Tech.

Semester: Eighth

Professional Elective Course (UPE-V)

Subject Name: Soil Dynamics & Earthquake Engineering

(3-0-0) CR-03

Course Content**Module-I**

THEORY OF VIBRATIONS: Difference between static loading and dynamic loading,- degree of freedom- idealization of structures as single degree of freedom system – Formulation of Equations of motion of SDOF system - D'Alemberts principles – effect of damping – free and forced vibration of damped and undamped structures – Response to harmonic and periodic forces.

Module-II

MULTIPLE DEGREE OF FREEDOM SYSTEM: Two degree of freedom system – modes of vibrations – formulation of equations of motion of multi degree of freedom (MDOF) system - Eigen values and Eigen vectors – Response to free and forced vibrations - damped and undamped MDOF system – Modal superposition methods.

Module-III

ELEMENTS OF SEISMOLOGY: Elements of Engineering Seismology - Causes of Earthquake – Plate Tectonic theory – Elastic rebound Theory – Characteristic of earthquake – Estimation of earthquake parameters - Magnitude and intensity of earthquakes – Spectral Acceleration.

Module-IV

RESPONSE OF STRUCTURES TO EARTHQUAKE: Effect of earthquake on different type of

structures – Behaviour of Reinforced Cement Concrete, Steel and Prestressed Concrete Structure under earthquake loading – Pinching effect – Bouchinger Effects – Evaluation of earthquake forces as per IS:1893 – 2002 - Response Spectra – Lessons learnt from past earthquakes.

Module-V

DESIGN METHODOLOGY: Causes of damage – Planning considerations / Architectural concepts as per IS:4326 – 1993 – Guidelines for Earthquake resistant design – Earthquake resistant design for masonry and Reinforced Cement Concrete buildings – Later load analysis – Design and detailing as per IS:13920 – 1993.

Text Books:

WT Thomsen, ‘Theory of vibration’, CBS Publications

M. Paz, ‘Structural Dynamics- Theory and Computation’, Van Nostrand, 1985

Course Outcomes:

1. Explain theory of structural vibration
2. Solve problems related to multi degree of freedom structures
3. Revise elements of engineering seismology
4. Determine how structures behave during earthquake
5. Design structures for seismic loading

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	3	1	1							
CO2	3	2	1	1	1							
CO3	2	1			3							
CO4	3	2	1	2	1	2						
CO5	3	2	3	2	1	1	3	1	2	2	2	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	3	2	2	1	1	1	1	0	0	0	0	0

Programme: B.Tech.

Semester: Eighth

Professional Elective Course (UPE-V)

Subject Name: Pavement Management System

(3-0-0) CR-03

Course Content

Module-I

Components of PMS and their activities; Major steps in implementing PMS; Inputs; Design, Construction and Maintenance; Rehabilitation and Feedback systems; Pavement Maintenance Management Components of Maintenance Management and Related Activities – Network and Project Level Analysis; Prioritization Techniques and Formulation of Maintenance Strategies.

Module-II

Techniques for functional and structural evaluation of pavements: Serviceability Concepts;

Visual Rating; Pavement Serviceability Index; Roughness Measurements ;Distress Modes – Cracking, Rutting, etc; Pavement Deflection – Different Methods and BBD, Skid Resistance, Roughness, Safety – Aspects; Inventory System. Causes of Deterioration, Traffic and Environmental Factors,

Module-III

Pavement Performance Modeling Approaches and Methods of Maintaining WBM, Bitumen and Cement Concrete Roads, Quality Assurance; Quality Control – ISO 9000, Sampling Techniques – Tolerances and Controls related to Profile and Compaction

Module-IV

Pavement rehabilitation techniques: overlay design procedures, recycling of flexible and rigid pavements

Module-V

Maintenance of paved roads: Fog spray, Slurry seal and micro surfacing, Treatments of cracks and joints in Rigid pavement, Mud Jacking.

Text Books:

1. Y. H. Huang, Pavement Analysis and Design, Seconded., Pearson Education
2. Rajib B. Mallick, Tahar El-Korchi, Pavement Engineering: Principles and Practice, Second Edition, CRC Press

Reference Books:

1. Ralph Haas, W. Ronald Hudson, John P. Zaniewski, Modern pavement management Modern Pavement Management, Krieger Pub Co 60
2. Croney, D. and P. Croney, The design and performance of road pavements, McGraw-Hill Book Company, London, UK.
3. Derek Pearson, Deterioration and Maintenance of Pavements, ICE Publishing
4. IRC: 81-1997 Guidelines for strengthening of flexible pavement.

Course Outcomes:

1. Design flexible pavement by various methods.
2. Evaluate design of rigid pavement by various methods.
3. Explain Pavement Performance.
4. Report Pavement rehabilitation techniques.
5. Revise Maintenance system of paved roads.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	1	1							
CO2	3	2	1	1	1							
CO3	2	1			2							
CO4	3	2	1	2	1	2						
CO5	3	2	3	2	1	1	2	1	2	2	2	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	3	2	1	1	1	1	0	0	0	0	0	1

Course Content

Module-I

Plane stress and plane strain problems. General stress and strain equations (Equilibrium and compatibility equations). Two dimensional problems in rectangular coordinates. Stress and strain components, differential equation, equilibrium equations and compatibility equations in polar coordinate.

Module-II

Stress distribution for axisymmetric problems. Pure bending of curved bars, thick walled cylinder. Concentrated force at a point of straight boundary. Force acting on the end of a wedge. Concentrated force acting on a beam. Effect of circular holes on stress distributions in plates.

Module-III

Stress and strain in three dimensions: Principal stresses, maximum shearing stress, principal axes of strain. Stretching of prismatic bar by its own axis. Elementary problems of elasticity in three dimensions

Module-IV

Torsion of non-circular prismatic bars, Saint Venant's theory, Various analogies, Torsion of hollow and thin section, Application of energy methods

Module-V

Introduction to the theory of plasticity, the yield criteria of metals, stress space representation of yield criteria, stress-strain relations plastic potential, flow rules and maximum work hypothesis. Two dimensional plastic flow problems. Incompressible two dimensional flow, stresses in plastic materials in condition of plane strain, equation of equilibrium the simplest slip-line fields.

Text Book:

1. S P Timoshenko and J N Goodier, Theory of Elasticity, Mc Graw Hill
2. Hoffman and Sachs, Theory of plasticity

Reference Books:

1. N. Filonenko-Borodich, Theory of Elasticity, Mir Publishers, Moscow, 1965
2. W. Johnson and P B Meller, Plasticity of Mechanical Engineers
3. C.R. Calladine, 'Plasticity for Engineers', Ellis Horwood, Chichester, U.K., 1985

Course Outcomes:

1. Apply the basic knowledge of elasticity and application of the concepts of stresses and strain.
2. Identify, formulate and solve engineering problems with respect to stress and strain as applied to 2D elements in Cartesian and polar coordinates.
3. Solve engineering problems with respect to stress and strain as applied to 3D elements in

Cartesian and polar coordinates.

4. Evaluate engineering problems as applied to Torsion of Prismatic bars.

5. Use techniques to solve engineering problems with respect to Plasticity and how exactly applied to the structural systems.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	3	1	1							
CO2	3	2	1	1	1							
CO3	2	1			3							
CO4	3	2	1	2	1	2						
CO5	3	2	2	2	1	1	2	1	2	2	2	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	3	2	1	1	1	1	0	0	0	0	0	0

Programme:B.Tech.

Semester:Eighth

Professional Elective Courses(UPE-V)

Subject Name: Traffic Engineering& Management

(3-0-0) CR-03

Course Content

Module-I

Traffic Studies: Basic characteristics of Traffic, Volume, Speed and Density; Definitions and their interrelationships; Traffic Volume studies - Objectives, Methods of Volume counts, Presentation of Volume Data; Speed studies- Types of Speeds, Objectives, Methods of speed studies, Statistical Methods for speed data Analysis, Presentation of speed data. Delay Studies; Head ways and Gap Studies - Headway and Gap acceptance, Origin and Destination Studies.

Module-II

Parking Studies: parameters of parking, definitions, Parking inventory study, Parking survey by Patrolling method; Analysis of Parking Survey data; Accident studies- Causative factors of Road accidents, Accident data collection: Accident analysis and modelling; Road Safety Auditing, Measures to increase Road safety.

Module-III

Capacity and LOS Analysis: Introduction to Traffic capacity Analysis, Concepts of Level of Service, Basic definitions, Factors affecting Capacity and LOS, Capacity of Urban/Rural Highway, With or without access control, Basic freeway segments - Service flow rate of LOS, Lane width or Lateral clearance adjustment; Heavy vehicle adjustment; Driver population adjustment.

Module-IV

Signal Designing – Fixed Time signals, Determination of Optimum Cycle length and Signal setting for Fixed Time signals, Warrants for Signals, Time Plan Design for Pre-Timed Control-Lane group analysis, Saturation flow rate, and Adjustment factors, Uniform and Incremental

Delay, Vehicle Actuated Signals, Signal Coordination.

Module-V

Transportation System Management - Measures for Improving vehicular flow – one way Streets, Signal Improvement, Transit Stop Relocation, Parking Management, Reversible lanes- Reducing Peak Period Traffic - Strategies for working hours, Congestion Pricing, Differential Toll Policies.

Text Books:

1. Transportation Engineering - An Introduction - C.JotinKhisty, Prentice Hall Publication
2. Traffic Engineering and Transportation Planning – L.R. Kadiyali, Khanna Publishers

Reference Books:

1. Traffic Engineering - Theory & Practice - Louis J.Pignataro, Prentice Hall Publication.
2. Traffic Engineering by Roger P.Roess, William R. Mc. Shane, Elena S.Prassas, PrenticeHall, 1977.
3. Fundamentals of Transportation Engineering - C.S.Papacostas, Prentice Hall India
4. Fundamentals of Traffic Engineering – McShane & Rogers.
5. Principles of Highways Engineering and Traffic Analysis - Fred Mannering & Walter Kilareski, John Wiley & Sons Publication
6. IRC Codes
7. Highway Capacity Manual -2010.

Course Outcomes:

1. Employ traffic survey, collects data, analyse and interpret them.
2. Manage Parking
3. Analyze LOS of an operating highway.
4. Design of signal and manage the traffic.
5. Develop short term traffic management.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	1	1							
CO2	3	2	1	1	1							
CO3	2	1			3							
CO4	3	2	1	3	1	2						
CO5	3	2	3	2	1	1	2	1	2	3	2	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	3	2	1	1	1	1	0	0	0	1	0	0

Professional Elective Courses (UPE-VI)

Subject Name: Advance Foundation Engineering

(3-0-0) CR-03

Course Content

Module-I

Planning of soil exploration for different projects, methods of subsurface exploration, methods of borings along with various penetration tests.

Module-II

Shallow foundations, requirements for satisfactory performance of foundations, methods of estimating bearing capacity, settlements of footings and rafts, proportioning of foundations using field test data, IS codes

Module-III

Pile foundations, methods of estimating load transfer of piles, settlements of pile foundations, pile group capacity and settlement, negative skin friction of piles, laterally loaded piles, pile load tests, analytical estimation of load- settlement behavior of piles, proportioning of pile foundations, lateral and uplift capacity of piles.

Module-IV

Well foundation, IS and IRC codal provisions, elastic theory and ultimate resistance methods.

Module-V

Foundations on problematic soils and Cofferdams: Foundations for collapsible and expansive soil, various types and analysis of coffer dams and design Foundations under uplifting loads.

Reference Books:

1. Bowles. J.E., Foundation Analysis and Design, Tata McGraw-Hill International Edition, 5th Edn, 1997.
2. Das B.M., Shallow Foundations: Bearing capacity and settlement, CRC Press, 1999.
3. Tomlinson M.J., Pile design and construction Practice, Chapman and Hall Publication, 1994.
4. Poulos, H. G. and Davis, F. H., “Pile Foundation Analysis and Design”, Wiley and Sons. 1980

Course Outcomes:

1. Explain the type of foundations to be recommended for construction of different engineering structures by conducting various boring and penetration tests.
2. Analyze and design different types of shallow foundations.
3. Evaluate pile resistance and deflection under lateral loads.
4. Report the details of well foundations.
5. Design foundations on problematic soils.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	1	1							
CO2	3	2	1	1	1							
CO3	2	1			2							
CO4	3	2	1	2	1	2						
CO5	3	2	3	3	1	1	2	1	2	2	2	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	3	2	1	1	1	1	0	0	0	0	0	0

Programme: B.Tech.

Semester: Eighth

Professional Elective Courses (UPE-VI)

Subject Name: Pavement Design

(3-0-0) CR-03

Course Content

Module-I

Factors Affecting Pavement Design: Design life, reliability, traffic, climate, road geometry, material properties, and drainage.

Module-II

Stresses In flexible Pavement: Vehicle-Pavement Interaction: Transient, Random & Damping Vibrations, Steady State of Vibration, Experiments on Vibration, Stress Inducing Factors in Flexible and Rigid pavements; Stress In Flexible Pavements: Visco-Elastic Theory and Assumptions, Layered Systems Concepts, Stress Solutions for One, Two and Three Layered Systems, Fundamental Design Concepts.

Module-III

Stresses in Rigid Pavements: Westergaard's Theory and Assumptions, Stresses due to Curling, Stresses and Deflections due to Loading, Frictional Stresses, and Stresses in Dowel Bars & Tie Bars.

Module-IV

Design of Flexible Pavements: Factors effecting Design. Deflection studies in Flexible Pavements. Present Serviceability Index. IRC guidelines for Flexible Pavements. Pavement Performance and methods- AASHTO and Asphalt Institute Method. Need for Overlays, Overlays design methods for Flexible and Rigid pavements.

Module-V

Design of Rigid Pavements: Factors affecting Design - Wheel load & its repetition, sub grade strength & proportion, strength of concrete- modulus of elasticity. Reinforcement in slab. Design of joints. Design of Dowel bars. Design of Tie bars. IRC and AASHTO methods of Rigid Pavement design.

Text Books:

1. Pavement Analysis & Design, Yang H. Huang, Prentice Hall Inc.

Reference Books:

1. Design of Functional Pavements, Nai C. Yang, McGraw Hill Publications

2. Concrete Pavements, AF Stock, Elsevier, Applied Science Publishers

3. Principles of Pavement Design, Yoder.J. &Witzorac Mathew, W. John Wiley & Sons Inc

4. Pavement and Surfacing for Highway & Airports, MichealSargious, Applied Science Publishers Limited.

5. IRC: 37 & 58 Codes for Flexible and Rigid Pavements Design.

Course Outcomes:

1. Explain concepts of pavement stresses and performance.
2. Show and apply knowledge of the principles and practices of sustainable pavement design.
3. Solve complex theoretical and technical problems to design a pavement that meets given criteria and standards
4. Employ advanced analyses connected to material modelling and pavement design.
5. Evaluate structural condition of pavement

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	1	1							
CO2	3	2	1	1	1							
CO3	2	1			3							
CO4	3	2	1	2	1	2						
CO5	3	3	3	2	1	1	2	1	2	2	3	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	3	2	1	1	1	1	0	0	0	0	1	0

Programme: B.Tech.

Semester: Eighth

Professional Elective Courses (UPE-VI)

Subject Name: Ground Water Engineering

(3-0-0) CR-03

Course Content

Module-I

Introduction: Ground water theories, Trends in withdrawal and utilization of ground water, Ground water in hydrologic cycle, Hydrologic budget

Occurrence of groundwater: Origin and age of ground water, rock properties affecting ground water, vertical distribution of ground water, zone of aeration, zone of saturation, geologic formations as aquifers, types of aquifers, storage coefficient, ground water basins, springs, hydrothermal phenomena, groundwater in permafrost regions

Module-II

Groundwater movement: Darcy's law, permeability, determination of hydraulic conductivity, anisotropic aquifers, groundwater flow rates, groundwater flow directions, dispersion, groundwater tracers, general flow equations, unsaturated flow, kinematic wave, the Green-Ampt method for infiltration estimation

Module-III

Wells: Test holes and well logs, testing wells for yield, total pumping head of well, horizontal wells, characteristic well losses and their evaluation, specific capacity and efficiency of well, well-skin effect

Groundwater and well hydraulics: Steady unidirectional flow, steady radial flow to a well, well in a uniform flow, unsteady radial flow in a confined aquifer, unsteady radial flow in an unconfined aquifer, unsteady radial flow in a leaky aquifer, location of aquifer boundary and well flow near

aquifer boundary, multiple well systems, partially penetrating wells, well flow for special condition

Module-IV

Environmental influences on groundwater levels: Time variation of groundwater levels, streamflow and groundwater levels, groundwater level fluctuations due to evapotranspiration, meteorological phenomena and tide, urbanization, earthquake, external load, land subsidence and global climate change influences on groundwater levels

Groundwater flow modelling: Groundwater flow models (definition and types), cause of development and steps in development of groundwater flow models

Module-V

Management of groundwater: Fundamental concept of groundwater basin management, groundwater basin investigations and data collection, yield, conjunctive use and watershed management, water laws and policies, groundwater management models(definition and types),groundwater management modelling(hydraulic modelling, policy evaluation and allocation modelling and optimal control modelling)

Text Books:

1. Todd, D.K., Mays, L.W. "Groundwater Hydrology", Wiley.
2. Raghunath, H.M. "Groundwater" New Age International Publisher
3. Mahajan, G. "Evaluation and Development of Groundwater" APH.
4. Agarwal, V.C. "Groundwater Hydrology", PHI Learning Pvt. Ltd.

Course Outcomes:

1. Explain about occurrence of groundwater
2. Determine movement of groundwater
3. Revise well hydraulics
4. Analyze environmental influences on groundwater levels
5. Report about groundwater management models

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	3	1	1							
CO2	3	2	1	1	1							
CO3	2	1			3							
CO4	3	2	1	2	1	2						
CO5	3	2	3	2	1	1	2	1	3	2	2	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	3	2	2	1	1	1	0	0	1	0	0	0

Programme: B.Tech.

Semester: Eighth

Professional Elective Courses (UPE-VI)

Subject Name: Concrete Technology

(3-0-0) CR-03

Course Content

Module-I

Introduction of concrete, Historic development, Composition of concrete, Advantages of concrete over other materials, Advances and future trends in concrete, Overview of Sustainability and Concrete development.

Cement: Production, composition, and properties; cement chemistry, Types of cements; special cements; Aggregates: Classification, IS specifications, Properties, Grading, Methods of combining aggregates, specified gradings, Testing of aggregates; Water : General requirements & limiting values of impurities.

Module-II

Admixtures: Water reducers, air entrainers, set controllers, special admixtures - structure properties and effects on concrete properties; Introduction to supplementary cementing materials and pozzolans; Other mineral additives - reactive and inert.

Concrete mix design: Basic principles; IS method; ACI method; new approaches based on rheology and particle packing.

Module-III

Concrete Production & Fresh concrete: Batching of ingredients; mixing, transport, and placement; Consolidation, finishing, and curing of concrete; initial and final set - significance and measurement; Workability of concrete and its measurement. Engineering properties of concrete: Compressive strength and parameters affecting it; Tensile

strength -direct and indirect; Modulus of elasticity and Poisson's ratio; Stress strain response of concrete.

Module-IV

Dimensional stability and durability: Introduction to durability; relation between durability and permeability; Chemical attack of concrete; corrosion of steel rebars; other durability issues; Creep and relaxation - parameters affecting; Shrinkage of concrete - types and significance; Parameters affecting shrinkage; measurement of creep and shrinkage.

Non-Destructive testing of concrete: Introduction to Destructive, semi -destructive & Nondestructive testing methodology, Problems faced during Non-destructive evaluation, Test methods like Rebound Hammer test, Ultra-sonic pulse velocity, Penetration tests, Pull out test

Module-V

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

Overview of Fracture Mechanics: Origin of fracture mechanics, Understanding the quasi-brittle nature of concrete, Failure of concrete under low stress, Micro-cracking, crack propagation, stress concentration at openings.

Text Books:

1. A. M. Neville, Concrete Technology (English) 1st Edition; Pearson India publications.
2. M.L. Gambhir, Concrete Technology, 5th Edition; by; McGraw Hill Education (India) Private Limited.

Reference Books:

1. P. Kumar Mehta, and Paulo J.M. Monteiro; Concrete: microstructure properties and
2. materials: Tata McGraw Hill Education Private Limited
3. M S Shetty, Concrete Technology: Theory and Practice; 7th Edition;; S. Chand & Company Ltd- New Delhi.

Course Outcomes:

1. Explain the properties of constituent materials of concrete
2. Prepare concrete design mix
3. Determine engineering properties of concrete
4. Report the durability and conduct nondestructive tests on concrete
5. Revise special types of concretes and concrete fracture mechanics

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	1	1							
CO2	3	2	1	1	1							
CO3	3	1			3							
CO4	3	2	1	2	1	3						
CO5	3	2	3	2	1	1	2	1	2	2	2	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	3	2	1	1	1	1	0	0	0	0	0	0

Programme: B.Tech.

Semester: Eighth

Professional Elective Courses (UPE-VI)

Subject Name: Environmental Geotechnique

(3-0-0) CR-03

Course Content

Module-I

Sources and Site Characterization: Scope of Environmental Geotechnics, Various Sources of Contaminations, Need for contaminated site characterization; and Characterization methods.

Module-II

Solid and Hazardous Waste Management: Classification of waste, Characterization solid wastes, Environmental Concerns with waste, waste management strategies.

Module-III

Contaminant Transport: Transport process, Mass-transfer process, Modeling, Bioremediation, Phytoremediation.

Module-IV

Remediation Techniques: Objectives of site remediation, various active and passive methods, remediation NAPL sites, Emerging Remediation Technologies, Geosynthetics: Types, Functions and Design.

Module-V

Landfills: Types of landfills, Site Selection, Waste Containment Liners, Leachate collection system, Cover system, Gas collection system, Ash pond Dykes: Design.

Text Books:

1. Phillip B. Bedient, Refai, H. S. & Newell C. J. - Ground Water Contamination - Prentice Hall

2. Sharma, H. D. and Reddy, K. R. - Geoenvironmental Engineering, John Wiley & Sons (2004)

Reference Books:

1. Rowe, R. K. - Geotechnical & Geoenvironmental Engineering Handbook, Kluwer Academic, 2001.
2. Reddi, L. N. and Inyang, H. I. - Geoenvironmental Engineering Principles and Applications, Marcel. Dekker, Inc., New York, 2000.
3. LaGrega, M. D., Buckingham, P. L. and Evans, J. C. - Hazardous Waste Management, New York: McGraw-Hill, 2001

Course Outcomes:

1. Explain the principles and methods of civil engineering (geotechnics) and its relation to environment
2. Determine various engineering properties of wastes.
3. Report subsurface contamination and different remediation process.
4. Revise the primary considerations for design, constructions, quality control and risk Assessment.
5. Analyze and design engineering landfill and ash pond dykes.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	1	1							
CO2	3	2	1	1	1							
CO3	3	1			3							
CO4	3	2	1	2	1	2						
CO5	3	2	3	2	1	1	2	1	2	2	2	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	3	2	1	1	1	1	0	0	0	0	0	0

Programme: B.Tech.

Semester: Eighth

Professional Elective Courses (UPE-VI)

Subject Name: Prestressed Concrete

(3-0-0) CR-03

Course Content

Module-I

Introduction to prestressed concrete: types of prestressing, systems and devices, materials. Analysis of PSC flexural members: basic concepts, stresses at transfer and service loads, ultimate strength in flexure, code provisions.

Module-II

Losses in pre tensioned and post tensioned members. Deflection of prestressed concrete structures- short term as well as long term deflections of uncracked and cracked members

Module-III

Statically determinate PSC beams: design for ultimate and serviceability limit states for flexure, analysis and design for shear and torsion, code provisions.

Module-IV

Anchorage zone stresses for post tensioned Members; Magnel's method, Guyon's method, Rowe's method and IS code method of design.

Module-V

Indeterminate structures- Principles of design of prismatic continuous beams of two equal, unequal spans with same and variable moments of inertia, Analysis and design -continuous beams, choice of cable profile, linear transformation and concordancy of cable profile.

Course Outcomes:

1. Explain the basic aspects of prestressed concrete fundamentals, including pre and post-tensioning processes and determine the prestressing force required in beam for a prestressing systems.
2. Determine losses and deflections in the prestressed concrete.
3. Compute the Flexural Strength, Shear strength & Torsional Resistance of prestressed Concrete Members.
4. Design of end blocks for prestressed members.
5. Analyse and design statically indeterminate prismatic continuous beams.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	3	1	1							
CO2	3	2	1	1	1							
CO3	2	1			3							
CO4	3	2	1	2	1	2						
CO5	3	2	3	3	1	1	2	1	2	2	2	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	3	2	2	1	1	1	0	0	0	0	0	0

Programme: B.Tech.

Semester: Eighth

Open Elective Courses (UOE-IV)

Subject Name: Finite Element Method

(3-0-0) CR-03

Course Content

Module-I

The Continuum, Equations of Equilibrium, Boundary Conditions, Strain displacement relations, Stress strain Relations, Plane stress and plane Strain problems, Different methods of structural analysis including numerical methods. Basics of finite element method (FEM), different steps involved in FEM, Different approaches of FEM, Direct method, Energy approach, Weighted residual Method.

Module-II

One and Two Dimensional Problems: Detail formulation including shape functions, stress strain relations,

strain displacement relations and derivation of stiffness matrices using energy approach, Assembling of element matrices, application of displacement boundary conditions, Numerical solution of one dimensional problems using bar, truss, beam elements and frames. Derivation of shape function using Lagrange's interpolation, Pascal's triangle, Convergence criteria, Finite Element modeling of two dimensional problems using Constant strain Triangle (CST) elements, Stress strain relations for isotropic and orthotropic materials, Four noded rectangular elements, axisymmetric solids subjected to axisymmetric loading.

Module-III

Isoparametric Elements: Natural coordinates, isoparametric elements, four node, eight node elements. Numerical integration, order of integration

Module-IV

Plate Bending: Bending of plates, rectangular elements, triangular elements and quadrilateral elements, Concept of 3D modeling.

Module-V

Dynamic Considerations: General Equation of motion, Lagrange's approach, mass matrix, lumped and consistent mass matrices, Evaluation of eigenvalue and eigenvectors, stability problems.

Text Book:

1. C.S. Desai and J.F. Abel, Introduction to the Finite Element Method: CBS Publishers
2. R. D. Cook., Concepts and Applications of Finite Element Analysis, Wiley.

Reference Books:

1. Logan, D. L., A First Course in the Finite Element Method, PWS Publishing, Boston,
2. O. C Zienkiewicz .and R. L. Taylor, Finite Element Method, Mc Graw Hill

Course Outcomes:

1. Revise the basic knowledge of mathematics, science and engineering in the areas of finite element analysis related to structural engineering.
2. Identify, formulate and solve engineering problems of structural engineering related to one and two dimensional structures.
3. Explain about structures using isoperimetric elements
4. Solve plate bending problems
5. Analyse structures subjected to dynamic loads

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	3	1	1							
CO2	3	2	1	1	1							
CO3	2	1			3							
CO4	3	2	1	2	1	2						
CO5	3	2	3	2	1	1	2	1	2	3	2	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	3	2	2	1	1	1	0	0	0	1	0	0

Programme: B.Tech.

Semester: Eighth

Open Elective Courses (UOE-IV)

Subject Name: Environmental Management

(3-0-0) CR-03

Course Content

Module-I

Principles of Environmental Management, Ecosystem Concepts, Environmental Concerns in India, Policy and Legal Aspects of Environmental Management, Introduction to Environmental Policies, Environmental Laws and Legislations, Environmental Legislations in India.

Module-II

Environmental Impact Assessment (EIA), Impact Prediction, Evaluation and Mitigation, Forecasting Environmental Changes, Strategic Environmental Assessment (SEA), Environmental Clearance Procedure in India, EIA Documentation and Processes, EIA Monitoring and Auditing.

Module-III

Environmental Auditing, Elements of Audit Process, Waste Audits and Pollution Prevention Assessments, EA in Industrial Projects.

Module-IV

Life Cycle Assessment (LCA), Stages in LCA of a Product, Procedures for LCA, Different Applications of LCA. Sustainable approach towards Environment Management, Environmental Protocols

Module-V

Environmental Management System Standards, Implementation of EMS Conforming to ISO 14001. Environmental Economics: Introduction, economic tools for evaluation, Green GDP, Cleaner development mechanisms and their applications.

Text Book:

1. Vijay Kulkarni and Ramachandra T.V., 2006. Environmental Management, Commonwealth of Learning, Canada and Indian Institute of Science, Bangalore.

Reference Books:

1. Lohani B.N (1984)., "Environmental Quality Management", South Asian Publishers, New Delhi
2. Chanlett, (1973) "Environmental Protection", McGraw Hill Publication, New York.
3. Danoy G.E., and Warner R.F., (1969), "Planning and Design of Engineering Systems", Unwin Hyman Publications.
4. MOEF, Government of India, "Carrying Capacity Based Developmental Planning Studies for the 6. National Capital Region", 1995-96.

Course Outcomes:

1. Explain the principles of environmental management.
2. Revise environmental impact prediction, evaluation and mitigation.
3. Identify and review audit-related documentation, prepare checklists and audit process
4. Apply tools such life cycle assessment, environmental audits, evaluation of environmental performance for environmental decision-making.

5. Evaluate the effectiveness of systematic EMS monitoring processes and to understand Implementation of EMS Conforming to ISO 14001

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	3	1	1							
CO2	3	2	1	1	1							
CO3	2	1			3							
CO4	3	2	1	2	1	3						
CO5	3	2	3	2	1	1	3	1	2	2	2	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	3	2	2	1	1	1	1	0	0	0	0	1