9th

Meeting of Board of Studies

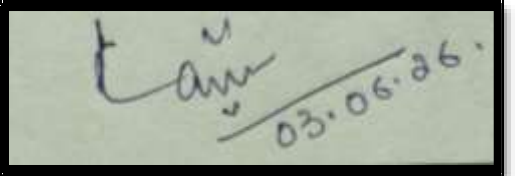
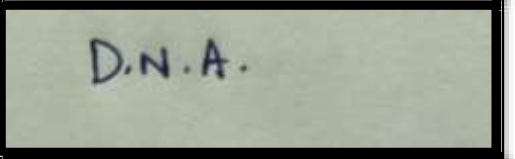
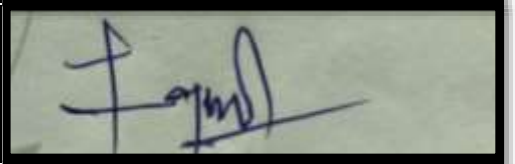
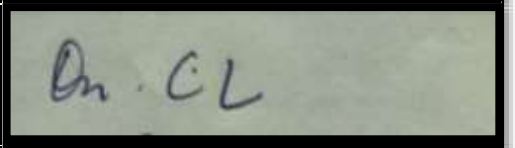
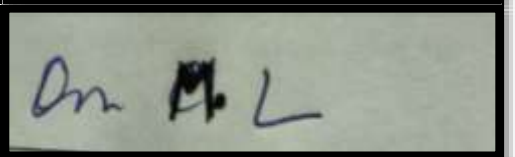
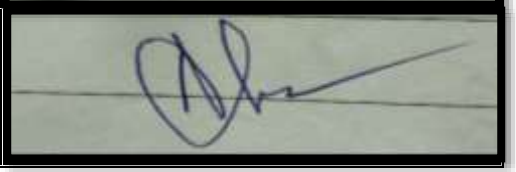
(Department of Civil Engineering, IUST)

3rd of June, 2026

Venue: University Campus Awantipora

Islamic University of Science and Technology, Kashmir

SIGNATORIES:

S. No	Name of the Member	Signature
1	**Dr. Kaiser Javid Giri** Chairperson, BOS	
2	**Dr. Shujaat Hussain** Head of Department & Member Secretary	
3	**Prof. Sharad Jain** External Subject Expert	
4	**Dr. Khalid Muzamil Gani** HVC Nominee	
5	**Er. Iftikhar Ahmad Kakroo** Industrial Expert	
6	**Er. Mohd Iqbal Mirza** Member	
7	**Er. Misba Gul** Member Invitee	
8	**Er. Riyaz Ahmad Qasab** Member	
9	**Er. Mohd Dilawar Bhat** Member/ BOS Coordinator	
10	**Er. Mehnaza Akhter** Member	
11	**Er. Mir Aijaz Ahmad** Member Invitee	

Semester Wise Credit Structure and Distribution

Semester	PCC	PEC	ESC	BSC	HSMC	MOPEC	PR + INT (Including Seminar)	IKS (Indian Knowledge System)	MNCC-AU	Total Credits
1st	**0**	**0**	**03**	**12**	**03**	**0**	**0**	**0**	**2 Courses**	**18**
2nd	**0**	**0**	**16**	**04**	**0**	**0**	**0**	**0**	**1 Course**	**20**
3rd	17	03	0	0	0	0	0	0	0	**20**
4th	17	03	0	0	0	2	0	01	0	**23**
5th	18	03	0	0	0	2	0	0	0	**23**
6th	17	03	0	0	0	2	0	01	0	**23**
7th	13	03	0	0	0	2	04	0	0	**22**
8th	04	03	0	0	0	0	12	0	0	**19**
Total Credits	**86**	**18**	**19**	**16**	**03**	**08**	**16**	**02**	**0**	**168**

COURSE STRUCTURE SEMESTER I

S. No	Course Code	Course Title	Course Category	Per Week				Credits
				L	T	P	S	
1	MTH115C	Calculus for Engineers	BSC	3	1	0	0	4
2	PHY102C	Engineering Physics	BSC	3	0	2	0	4
3	CHM102C	Engineering Chemistry	BSC	3	0	2	0	4
4	CIV101A	Introduction to Environmental Science and Engineering	MNCC-AU	2	0	0	1	0
5	MEC102C	Engineering Visualisation	ESC	1	0	4	0	3
6	ENG107F	Technical Communication	HSMC	2	0	2	0	3
7	MEC104A	Engineering Perspectives	MNCC-AU	1	0	0	1	0
Total Credits								**18**

COURSE STRUCTURE SEMESTER II

S. No	Course Code	Course Title	Course Category	Per Week				Credits
				L	T	P	S	
1	MTH155C	Linear Algebra and Differential Equations	BSC	3	1	0	0	4
2	CIV152C	Engineering Mechanics	ESC	3	0	0	0	3
3	ELE150C	Basic Electrical Engineering	ESC	3	0	2	0	4
4	CSE160F	Programming for Problem Solving	ESC	3	0	2	0	4
5	ECE151C	Basic Electronic Devices	ESC	3	0	0	0	3
6	MEC152C	Product Realisation through Manufacturing	ESC	0	0	2	1	2
7	SS01A	Ethics and Social Responsibilities	MNCC-AU	1	0	0	0	0
Total Credits								**20**

COURSE STRUCTURE SEMESTER III								
S. No	Course Code	Course Title	Course Category	Credits	Contact Hours	Per Week		
						L	T	P
1.	CIV-201-C	Structural Analysis-I	PCC	3	45	2	1	0
2.	CIV-202-C	Surveying-I	PCC	3	45	2	1	0
3.	CIV-203-C	Fluid Mechanics-I	PCC	3	45	2	1	0
4.	CIV-204-C	Building Materials & Construction	PCC	3	45	2	1	0
5.	CIV-205-C	Applied Statistics and Mathematics for Civil Engineering	PCC	2	30	2	0	0
6.	CIV-206-E	Construction Technology	PEC	3	45	2	1	0
	CIV-207-E	Introduction to Geotechnical Engineering						
	CIV-208-E	Introduction to Green Technology						
	CIV-209-E	Introduction to Water Supply and Sanitation						
	CIV-210-E	Introduction to Pavement Materials						
	CIV-211-E	Soft Skill for Civil Engineers						
7.	CIV-216-C	Structure Lab-I	PCC	1	30	0	0	2
8.	CIV-217-C	Surveying Lab-I	PCC	1	30	0	0	2
9.	CIV-218-C	Fluid Mechanics Lab-I	PCC	1	30	0	0	2
Total Credits				20				
10.	CIV-246-C	Introduction to Sustainability	Optional	3	45	3	0	0

COURSE STRUCTURE SEMESTER IV								
S. No	Course Code	Course Title	Course Category	Credits	Contact Hours	Per Week		
						L	T	P
1.	CIV-250-C	Structural Analysis-II	PCC	3	45	2	1	0
2.	CIV-251-C	Surveying- II	PCC	3	45	2	1	0
3.	CIV-252-C	Fluid Mechanics-II	PCC	3	45	2	1	0
4.	CIV-253-C	Civil Engineering Construction & Architectural Drawing	PCC	3	45	2	1	0
5.	CIV-254-C	Sustainable Practices in Indian Knowledge System	IKS	1	15	1	0	0
6.	CIV-255-E	Construction Management	PEC	3	45	2	1	0
	CIV-256-E	Engineering Geology and Seismology						
	CIV-257-E	Environmental Pollution and Control						
	CIV-258-E	Fluid Mechanics Applications in Engineering						
	CIV-259-E	Road Safety and Management						
	CIV-260-E	Entrepreneurship & Start-ups in Civil Engineering						
7.	CIV-266-C	Structure Lab-II	PCC	1	30	0	0	2
8.	CIV-267-C	Surveying Lab-II	PCC	1	30	0	0	2
9.	CIV-268-C	Fluid Mechanics Lab-II	PCC	1	30	0	0	2
10.	CIV-269-C	Computer Based Drafting Lab	PCC	1	30	0	0	2
11.	CIV-270-C	Survey Camp	PCC	1	30	0	0	2
12.	MOPEC	Open Elective	MOPEC	2	30	-	-	-
Total Credits				23				
13.	CIV-296-C	Sustainable Infrastructure Design & Planning	Optional	3	45	3	0	0

COURSE STRUCTURE SEMESTER V								
S. No	Course Code	Course Title	Course Category	Credits	Contact Hours	Per Week		
						L	T	P
1.	CIV-301-C	Design Of Concrete Structures-I	PCC	3	45	2	1	0
2.	CIV-302-C	Geotechnical Engineering-I	PCC	3	45	2	1	0
3.	CIV-303-C	Water Supply Engineering	PCC	3	45	2	1	0
4.	CIV-304-C	Concrete Technology	PCC	3	45	2	1	0
5.	CIV-305-C	Quantity Survey & Cost Estimation	PCC	3	45	2	1	0
6.	CIV-306-E	Design Software	PEC	3	45	2	1	0
	CIV-307-E	Geotechnical Applications in Construction						
	CIV-308-E	Solid Waste Management						
	CIV-309-E	Groundwater Engineering						
	CIV-310-E	Sustainable Transportation Infrastructure						
	CIV-311-E	Integrated Waste Management for a Smart City						
7.	CIV-316-C	Geotechnical Engineering Lab-I	PCC	1	30	0	0	2
8.	CIV-317-C	Environmental Engineering Lab	PCC	1	30	0	0	2
9.	CIV-318-C	Concrete Technology Lab	PCC	1	30	0	0	2
10.	MOPEC	Open Elective	MOPEC	2	30	*	*	*
		Total Credits		**23**				
11.	CIV-346-C	Sustainable Materials and Construction	Optional	3	45	3	0	0

COURSE STRUCTURE SEMESTER VI								
S. No	Course Code	Course Title	Course Category	Credits	Contact Hours	Per Week		
						L	T	P
1.	CIV-350-C	Design Of Steel Structures	PCC	3	45	2	1	0
2.	CIV-351-C	Geotechnical Engineering-II	PCC	3	45	2	1	0
3.	CIV-352-C	Transportation Engineering -I	PCC	3	45	2	1	0
4.	CIV-353-C	Engineering Hydrology	PCC	3	45	2	1	0
5.	CIV-354-C	Structural Analysis-III	PCC	3	45	2	1	0
6.	CIV-355-C	Traditional Wisdom for Earthquake Resistant & Disaster Resilient Designing.	IKS	1	15	1	0	0
7.	CIV-356-E	Advanced Structural Analysis	PEC	3	45	2	1	0
	CIV-357-E	Rock Mechanics & Tunnelling Technology						
	CIV-358-E	Climate Change: Impacts, Adaptation, and Resilience in Civil Engineering						
	CIV-359-E	Rural and Urban Sanitation						
	CIV-360-E	Transport Innovations and Industrial Progress						
	CIV-361-E	Programming for Engineers						
8.	CIV-366-C	Geotechnical Lab-II	PCC	1	30	0	0	2
9.	CIV-367-C	Transportation Engineering Lab-I	PCC	1	30	0	0	2
10.	MOPEC	Open Elective	MOPEC	2	30	*	*	*
		Total Credits		**23**				
11.	CIV-396-C	Waste Management	Optional	3	45	3	0	0

COURSE STRUCTURE SEMESTER VII								
S. No	**Course Code**	**Course Title**	**Course Category**	**Credits**	**Contact Hours**	**Per Week**		
						L	**T**	**P**
1.	CIV-401-C	Design of Concrete Structures- II	PCC	3	45	2	1	0
2.	CIV-402-C	Irrigation & Hydraulic Structures	PCC	3	45	2	1	0
3.	CIV-403-C	Transportation Engineering-II	PCC	3	45	2	1	0
4.	CIV-404-C	Waste Water Engineering	PCC	3	45	2	1	0
5.	CIV-405-E	Design of Bridge Structures	PEC	3	45	2	1	0
	CIV-406-E	Geo-Environmental Engineering						
	CIV-407-E	Environment Impact Assessment & Audit						
	CIV-408-E	Hydropower Engineering						
	CIV-409-E	Transportation Planning And Economics						
	CIV-410-E	AI & Machine Learning in Civil Engineering						
6.	CIV-416-C	Seminar	PR	1	30	0	0	2
7.	CIV-417-C	Transportation Engineering Lab-II	PCC	1	30	0	0	2
8.	CIV-418-C	Pre -Project	PR	2	60	0	0	4
9.	CIV-419-C	Industrial Training	INT	1	30	0	0	2
10.	MOPEC	Open Elective	MOPEC	2	30-60	*	*	*
	Total Credits			**22**				
11.	CIV-446-C	Geo-Environmental Engineering	Optional	3	45	3	0	0

COURSE STRUCTURE SEMESTER VIII								
S. No	**Course Code**	**Course Title**	**Course Category**	**Credits**	**Contact Hours**	**Per Week**		
						L	**T**	**P**
1.	CIV-450-C	Earthquake Resistant Design	PCC	3	45	2	1	0
2.	CIV-451-E	Pre-Stressed Concrete	PEC	3	45	2	1	0
	CIV-452-E	Ground Improvement Techniques						
	CIV-453-E	Sustainable Environmental Practices and Quality Control						
	CIV-454-E	Industrial waste water treatment						
	CIV-455-E	Design and Maintenance of Roads						
	CIV-456-E	Contracts & Legal Aspects in Civil Engineering						
3.	CIV-466-C	Project	PR	12	360	0	0	24
4.	CIV-467-C	Dynamic and Earthquake Engineering Laboratory	PCC	1	30	0	0	2
	Total Credits			**19**				
6.	CIV-496-C	Capstone Project	Optional	3	90	0	0	6

Note: Out of the Six PEC (Professional Elective Courses) for each semester, the actual number to be floated will be decided session-wise in accordance to the availability of faculty strength and workload during that particular academic session.

DETAILED SYLLABUS

B.TECH. CIVIL ENGINEERING

(CORE COURSES)

(Batch 2026 & onwards)

PROGRAMME OBJECTIVES AND OUTCOMES

B.Tech.. Civil Engineering (Regular Programme)

Programme Objectives (POBs)

1. To establish a robust foundation in mathematical principles, scientific concepts, and engineering fundamentals enabling graduates to formulate solutions to complex civil engineering challenges.
2. To develop proficiency in the design, planning, and execution of sustainable infrastructure systems that demonstrate resilience to contemporary environmental and societal challenges.
3. To instill a profound awareness of professional ethics, environmental stewardship, and societal responsibilities inherent in the practice of civil engineering.
4. To nurture collaborative competencies for effective functioning within multidisciplinary teams and to cultivate sophisticated communication skills for engagement with diverse stakeholders.
5. To foster a culture of innovation, intellectual curiosity, and commitment to lifelong scholarly pursuit necessary for addressing emerging engineering paradigms.

Programme Outcomes (POs)

1. Apply engineering knowledge to analyze and solve complex civil engineering problems.
2. Design civil engineering systems considering environmental, societal, and economic constraints.
3. Conduct experiments and interpret data related to geotechnical, transportation, and structural systems.
4. Employ modern tools and digital techniques such as AutoCAD, GIS, and Total Station in project execution.
5. Demonstrate ethical, managerial, and entrepreneurial skills relevant to the civil engineering profession.

PROGRAMME	B.Tech.. Civil Engineering (Regular)
SEMESTER	3rd
COURSE TITLE	**Structural Analysis - I**
COURSE CODE	CIV-201-C
COURSE CATEGORY	Professional Core Course (PCC)

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
3	2	1	0	0	45

COURSE OBJECTIVES	
1.	This course aims to introduce the concepts of engineering mechanics of materials and the behaviour of the materials and structures under applied loads with respect to civil engineering design and analysis

COURSE CONTENT		
Units	**Description**	**Cont. Hours**
1.	**Basic concepts of structural analysis**:- Structure, structural engineering, Types of loads (point, uniformly distributed and varying), Types of supports and support reactions, free body diagrams, Equations of equilibrium, Principle of Superposition, Axial force, Bending moment, and Shear force in determinate beams (Simply supported beams, cantilever, and overhanging beams) and diagram of shear force and bending moment.	10
2.	**Symmetric Beam Bending**: Simple theory of bending, Bending and shear stress for regular sections, shear center.	9
3.	**Deflection of statically determinate beams**: Slope and deflection of beams by integration, area-moment method and conjugate beam method.	10
4.	**Compound stresses**: - Normal and tangential stresses, Principal stresses and strains, Principal planes, Mohr's circle of stress, Evaluation by analytical and graphical method.	8
5.	**Columns**: Fundamentals, column buckling theory, Euler's load for columns with different end conditions, limitations of Euler's theory, Problems with eccentric load.	8

COURSE OUTCOMES	
CO 1.	Explain the fundamental concepts of structural analysis, types of loads and supports, support reactions, and equations of equilibrium, and determine shear forces and bending moments in statically determinate beams.
CO 2.	Apply the theory of simple bending to determine bending stresses, shear stresses, and shear centre for regular cross-sections.
CO 3.	Determine the slope and deflection of statically determinate beams using the double integration, area-moment, and conjugate beam methods.
CO 4.	Analyse compound stress systems to determine principal stresses, principal strains, and principal planes using analytical methods and Mohr's circle.
CO 5.	Explain the fundamentals of columns and apply Euler's buckling theory to determine the critical buckling loads of columns with different end conditions.

TEXT BOOKS/REFERENCES		
S. No	**Book/Text Title**	**Author**
1.	Mechanics of Materials	Beer, P. F., Johnston (Jr.), E. R., Dewolf, J. T., and Mazurek, D. F
2.	Mechanics of Materials	Hibbeler, R. C
3.	Mechanics of Structures Vol. I (Strength of Materials	Shah, H. J., and Junnarkar, S. B
4.	Fundamentals of Solid Mechanics: A Treatise on Strength of Materials	Gambhir, M. L.
5.	Engineering Mechanics of Solids	Popov, E. P
6.	Mechanics of Materials	Gere, J. M., and Goodno, B. J.
7.	Mechanics of Materials	Craig (Jr.), R. R.,

PROGRAMME	B. Tech Civil Engineering (Regular)
SEMESTER	3rd
COURSE TITLE	**Surveying - I**
COURSE CODE	CIV-202-C
COURSE CATEGORY	Professional Core Course (PCC)

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
3	2	1	0	0	45

COURSE OBJECTIVES	
1.	Introduce students to the basic concepts, principles, and terminology of surveying, including different types of surveys (land, construction, topographic, geodetic) and their applications.
2.	Teach students various measurement methods, such as distance measurement (electronic and traditional methods), levelling, angle measurement, and traverse measurements
3.	Enable students to identify and quantify different sources of errors in survey measurements, including instrumental, environmental, and observational errors

COURSE CONTENT		
Units	**Description**	**Cont. Hours**
1.	Introduction: Definition- Classifications - Basic Principles-	03
2.	Equipment and accessories for ranging and chaining – Methods of ranging – well conditioned triangles – Errors in linear measurement and their corrections – Obstacles.	10
3.	Compass – Basic principles - Types - Bearing - Systems and conversions- Sources of errors - Local attraction - Magnetic declination-Dip - Adjustment of closing error – applications -	10
4.	Plane table and its accessories - Merits and demerits - Radiation - Intersection - Resection	10
5.	Level line - Horizontal line - Datum - Benchmarks -Levels and staves - Methods of levelling - Fly levelling - Check levelling - Procedure in levelling Curvature and refraction – Sources of Errors in levelling- Types of instruments	12

COURSE OUTCOMES	
CO 1.	Students will be able to apply geometric principles and mathematical concepts to solve real-world surveying problems, such as land area calculation and boundary determination.
CO 2.	Graduates will demonstrate proficiency in employing various surveying techniques to accurately measure distances, angles, and elevations in a surveying context.
CO 3.	Graduates will be capable of interpreting survey data and presenting findings through maps, charts, and reports that effectively communicate information to various stakeholders, such as land developers, engineers, and government agencies.
CO 4.	Students will be able to apply geometric principles and mathematical concepts to solve real-world surveying problems, such as land area calculation and boundary determination.
CO 5.	Graduates will demonstrate proficiency in employing various surveying techniques to accurately measure distances, angles, and elevations in a surveying context.

TEXT BOOKS/REFERENCES		
S. No	**Book/Text Title**	**Author**
1.	Surveying (volume I)	Dr. K. R. Arora
2.	Surveying (volume I)	S. K. Duggal
3.	A Text Book of Surveying	C L Kochher
4.	Surveying and levelling	P. B. Shahani

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	3rd
COURSE TITLE	**Fluid Mechanics-I**
COURSE CODE	CIV-203-C
COURSE CATEGORY	Professional Core Course (PCC)

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
3	2	1	0	0	45

COURSE OBJECTIVES	
1.	To develop the understanding of basic principles of mechanics of fluids at rest and in motion and their applications in solving the real engineering problems
2.	To imbibe basic laws and equations used for analysis of static and dynamic fluids.
3.	To develop understanding about hydrostatic law, principle of buoyancy and stability of a floating body and application of mass, momentum and energy equation in fluid flow.
4.	To inculcate the importance of fluid flow measurement and its applications in Industries.
5.	To be able to carry out dimensional analysis for various physical phenomenon occurring in nature.

COURSE CONTENT		
Units	**Description**	**Cont. Hours**
1.	**Unit I: Introduction** Physical properties of Fluids: Mass density, Viscosity, Compressibility, Vapour pressure, Surface tension, Capillarity, Ideal Fluids and Real Fluids; Newtonian and non-Newtonian fluids.	7
2.	**Unit II: Fluid Statics** Pressure Intensity, Pascal's law; Hydrostatic Law; manometers and its types; Hydrostatic forces on surface, Total pressure, Centre of pressure; Buoyancy, Centre of buoyancy, Stability of immersed and floating bodies, Metacentric height and its determination.	13
3.	**Unit III: Fluid Kinematics** Steady and unsteady; Uniform and non-uniform; laminar and turbulent flows; one-, two- and three-dimensional flows; Conservation of mass; Continuity equation; velocity field and acceleration; Streamlines, Streak lines and path lines and flow net; Elementary explanation of stream function and velocity potential; rotation, circulation and vorticity.	7

4.	**Unit IV: Fluid Dynamics** Equations of motion, Euler's equation of motion along a streamline and Bernoulli's equation; Bernoulli's equation for real flow; Applications of Bernoulli's equation; flow measurement through Venturimeter, Orifice-meter, Pitot tube; Orifices & mouth- pieces; Notches and weirs, Classification of Notches and Weirs, Nappe, Crest/Sill.	11
5.	**Unit V: Dimensional Analysis** Dimensional homogeneity, Primary and Secondary dimensions, Rayleigh method & Buckingham's Π-theorem; Important Dimensionless numbers (Reynold's number, Froude's number, Euler's number); Kinematic and Dynamic similarity; Model Analysis and similitude.	7

COURSE OUTCOMES	
CO 1.	To analyze various Physical properties of fluids
CO 2.	Analyze and perform calculations on Pressure Intensity, force on plane and curved surfaces, center of pressure and metacentric height
CO 3.	Perform calculations for determination of Steady and unsteady, uniform and non-uniform, laminar and turbulent flows; one-, two- and three-dimensional flows; Stream lines, Streak lines and path lines.
CO 4.	Determine Euler's equation of motion along a streamline and its integration to yield Bernoulli's equation.
CO 5.	To carry out dimensional analysis for a physical phenomenon occurring in nature by using Buckingham's theorem

TEXT BOOKS/REFERENCES		
S. No	**Book/Text Title**	**Author**
1.	Fluid Mechanics and Fluid Power Engineering	Kumar, D.S.
2.	Engineering Fluid Mechanics	Garde R.J.
3.	Fluid Flow in Pipes & Channels	Asawa, GL,
4.	Engineering Fluid Mechanics	Kumar, K.L.
5.	Introduction to Fluid Mechanics and Fluid Machines	Som, S.K. and Biswas, G.,

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	3rd
COURSE TITLE	**Building Material & Construction**
COURSE CODE	CIV-204-C
COURSE CATEGORY	Professional Core Course (PCC)

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
3	2	1	0	0	45

COURSE OBJECTIVES	
1.	To aid practicing engineers in materials selection and design by understanding the interplay among structure, processing, properties, and performance.
2.	Introduction about basic building units and their suitability.
3.	To assess and evaluate the differences in material composition.
4.	To provides a broad overview of the field and serves.
5.	To know the pattern of lying of building units.

COURSE CONTENT		
Units	**Description**	**Cont. Hours**
1.	**Introduction to building materials.** Role of material in construction. Types of materials used in building construction. **Lime**: Classification & Types **Cement**: Classification/types and testing of cement. **Fly Ash**: Classification and Uses of Fly Ash **Mortar:** Classifications/types and their use. **Timber**: Classifications/types, and seasoning of timber. **Steel**: Classifications and their tests	**10**
2.	**Stones, Bricks and Concrete Blocks** Stone as building material: Criteria for selecting stones, Tests of stones, Deterioration and Preservation of stonework. Bricks as building material: Classification of bricks, Special and advanced bricks, Defects in bricks, Tests on bricks as Per Indian standard. Concrete Blocks: Types of concrete blocks advantages and disadvantages of concrete blocks.	**10**

3.	**Properties of Building materials.** Factors affecting properties of building materials, the importance of studying properties of building materials, introducing various	**10**
	properties of building materials e.g., structural properties, thermal, fire-related properties, and acoustic properties.	
4.	**Introduction of Building Practices and Building Elements.** Building codes and their objectives. Load-bearing structures and framed structures its suitability and importance. Types of loads. Introduction to building elements and Their Types. Foundation, Plinth, Floors, DPC, Walls, Slab, Stairs, Columns, Beams, Lintel, Roofs, Plaster, Doors, Windows, and Ventilators.	**10**
5.	**Masonry Construction:** Definition and terms used in masonry. Brick masonry, characteristics, and requirements of good brick masonry, Bonds in brickwork.	**5**

COURSE OUTCOMES	
CO 1.	Learner should differentiate the basic materials used in building construction.
CO 2.	Learner should analyze the requirements of modern material, our traditional one.
CO 3.	Learner should know building elements and their construction.

TEXT BOOKS/REFERENCES		
S. No	**Book/Text Title**	**Author**
1.	Building materials	Parbin Singh.
2.	Building materials and construction	Gurcharan Singh
3.	Building materials and construction	Ragawala.
4.	Building construction	Sushil Kumar.

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	3rd
COURSE TITLE	**Applied Statistics and Mathematics for Civil Engineering**
COURSE CODE	CIV-205-C
COURSE CATEGORY	Basic Science Course (BSC)

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
2	1	1	0	0	30

COURSE OBJECTIVES	
1.	To introduce the fundamental concepts of descriptive statistics and data visualization techniques to effectively summarize and interpret civil engineering-related datasets.
2.	To provide a foundation in probability theory and probability distributions for modeling uncertainty in civil engineering scenarios.
3.	To develop understanding of correlation and regression techniques for identifying relationships and making predictions from engineering data.

COURSE CONTENT		
Units	**Description**	**Cont. Hours**
1.	**Descriptive Statistics and Data Analysis** Introduction to types of data: qualitative and quantitative. Classification and tabulation of civil engineering data. Graphical representation: histograms, pie charts, frequency polygons. Measures of central tendency: mean, median, mode. Measures of dispersion: range, mean deviation, standard deviation. Applications: General application to summarize and interpret field and experimental data relevant to civil engineering.	**10**
2.	**Probability Concepts and Applications** Basic probability concepts: sample space, events, rules of probability. Introduction to probability distributions: Binomial, Poisson and Normal. Applications: General modelling of uncertainties and risks encountered in civil engineering projects.	**10**
3.	**Correlation and Simple Regression** Understanding correlation: Pearson's and Spearman's coefficients. Simple linear regression analysis. Least square estimation method for parameter estimation in simple regression. Applications: General use of predictive modelling and trend analysis in civil engineering observations and experiments	**10**

COURSE OUTCOMES	
CO 1.	Summarize and interpret civil engineering data using appropriate statistical tools including measures of central tendency, dispersion, and graphical methods.
CO 2.	Apply probability distributions to model uncertainties and risks commonly encountered in civil engineering design and decision-making.
CO 3.	Analyze relationships between variables and make data-driven predictions using correlation and regression methods applicable to engineering problems.
CO 4.	Summarize and interpret civil engineering data using appropriate statistical tools including measures of central tendency, dispersion, and graphical methods.
CO 5.	Apply probability distributions to model uncertainties and risks commonly encountered in civil engineering design and decision-making.

TEXT BOOKS/REFERENCES		
S. No	**Book/Text Title**	**Author**
1.	Probability and Statistics for Engineers and Scientists	R. E. Walpole, R. H. Myers et al.
2.	Basic Statistics	B. L. Agarwal
3.	Fundamentals of Mathematical Statistics	S. C. Gupta & V. K. Kapoor
4.	Applied Statistics and Probability for Engineers	Douglas C. Montgomery, George C. Runger
5.	Fundamentals of Statistics	A. M. Goon, M. K. Gupta, B. Dasgupta

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	3rd
COURSE TITLE	**Structure Lab-I**
COURSE CODE	CIV-216-C
COURSE CATEGORY	Professional Core Course (PCC)

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
1	0	0	2	0	30

COURSE OUTCOMES	
CO 1.	To evaluate the mechanical properties of materials such as steel and timber under various loading conditions including tension, compression, shear, and torsion.
CO 2.	To perform tests as per IS codes for determining the quality and suitability of construction materials like bricks and stones.
CO 3.	To determine bond behavior between steel and concrete through pull-out testing, and interpret material behavior from experimental results.

COURSE CONTENT		
Units	**Experiments**	**Cont. Hours**
1.	Tensile Test of Steel – Structural steel.	**5**
2.	Tensile Test of Round Steel Bars – Different Sizes.	**5**
3.	Tensile and Compressive Strength of Timber – Parallel and Perpendicular respectively.	**4**
4.	Shear Test of Timber.	**4**
5.	Impact Test of Steel – Charpy and Izod.	**4**
6.	Testing of Bricks and Stones as per IS Specifications.	**4**
7.	Pull-out Test on Steel Bars for Bond Strength Determination.	**4**

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	3rd
COURSE TITLE	**Surveying Lab-I**
COURSE CODE	CIV-217-C
COURSE CATEGORY	Professional Core Course (PCC)

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
1	0	0	2	20	30

COURSE OBJECTIVES	
1.	To use the basic surveying equipment viz Chain, tape, Compass
2.	To layout different types of traverses using chain/tape and compass.
3.	To handle & use Plane table with other accessories.
4.	To handle & use various types of levelling instruments viz, Dumpy level, Tilting Level
5.	To prepare L –sections and X-sections showing relative levels of various points

COURSE CONTENT		
Units	**Experiments**	**Cont. Hours**
1.	Study of chains and their accessories.	**2**
2.	Aligning, Ranging, and Chaining.	**2**
3.	Chain Traversing.	**2**
4.	Compass Traversing.	**2**
5.	Plane table surveying: Radiation.	**2**
6.	Plane table surveying: Intersection.	**2**
7.	Plane table surveying: Traversing.	**2**
8.	Plane table surveying: Resection – Three point problem.	**2**
9.	Plane table surveying: Resection – Two point problem.	**2**
10.	Study of levels and levelling staff.	**2**
11.	Fly levelling using Dumpy level.	**2**
12.	Fly levelling using tilting level.	**2**
13.	Check levelling.	**2**
14.	LS and CS.	**2**
15.	Contouring.	**2**

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	3rd
COURSE TITLE	**Fluid Mechanics Lab-I**
COURSE CODE	CIV-218-C
COURSE CATEGORY	Professional Core Course (PCC)

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**

COURSE OBJECTIVES	
1.	To develop understanding of hydrostatic law, the principle of buoyancy and stability of a floating body, and application of mass, momentum, and energy equation in fluid flow.
2.	To imbibe basic laws and equations used for the analysis of static and dynamic fluids.
3.	To teach the importance of fluid flow measurement and its applications in industries
4.	To give fundamental knowledge of fluid, its properties, and behaviour under various Conditions of internal and external flows.

COURSE CONTENT		
Units	**Experiments**	**Cont. Hours**
1.	To determine the metacentric height of a ship model experimentally.	**4**
2.	To verify Bernoulli's equation experimentally.	**4**
3.	To determine the coefficient of discharge, coefficient of velocity, and coefficient of contraction of an orifice or a mouthpiece of a given shape.	**4**
4.	To calibrate an orifice meter and to study the variation of coefficient of discharge with Reynold's number.	**4**
5.	To calibrate a Venturimeter and to study the variation of coefficient of discharge with Reynold's Number.	**5**
6.	To calibrate sharp-crested rectangular and triangular weir.	**5**
7.	To verify the momentum equation experimentally	**4**

COURSE OUTCOMES	
CO 1.	The ability to analyze experimental data and develop empirical equations.
CO 2.	Verification of basic principles and equations of fluid mechanics.
CO 3.	The ability to use computers for data analysis, empirical equations, and presentation

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	4th
COURSE TITLE	**Structural Analysis – II**
COURSE CODE	CIV-250-C
COURSE CATEGORY	Professional Core Course (PCC)

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
3	2	1	0	0	45

COURSE OBJECTIVES	
1.	To introduce the students to basic theory and concepts of classical methods of structural analysis

COURSE CONTENT		
Units	**Description**	**Cont. Hours**
1.	**Indeterminate Structures**: Introduction to indeterminate structures; stability, static and kinematic indeterminacy of structures viz. beams, frames, trusses.	6
2.	**Energy Methods of Analysis of Structures**: Strain energy and strain energy density – strain energy due to axial load (gradual, sudden, and impact loadings), shear, flexure. Castigliano's theorems – Maxwell's reciprocal theorem - Principle of virtual work - unit load method - application of energy theorems for computing deflections in determinate beams, plane frames, and plane trusses.	12
3.	**Force Methods of Analysis of Structures**: Method of least work, method of consistent deformation for analysis of indeterminate beams; continuous beams; deflection of truss joints; analysis of two hinged arches and Cleypryon's Three-Moment equation.	10
4.	**Displacement Methods of Analysis by slope and deflection method**: Analysis of indeterminate beams & frames (with & without sway) by classical displacement methods viz.; slope deflection method,	10
5.	**Displacement Methods of Analysis by moment Distribution method**: - Distribution factors, analysis of indeterminate Beams and Frames (with and without Sway) by moment distribution method.	7

COURSE OUTCOMES	
CO 1.	Identify the degree of indeterminacy of different types of structures.
CO 2.	Determine the strain energy and compute the deflection of determinate beams, frames and trusses using energy principles.
CO 3.	Analyse statically indeterminate structures by force & displacement methods and building frames by approximate methods for horizontal and vertical loads

TEXT BOOKS/REFERENCES		
S. No	**Book/Text Title**	**Author**
1.	Structural Analysis	Hibbeler, R. C. Pearson Prentice Hall.
2.	Fundamentals of Structural Analysis	Leet, K. M., and Uang, C. M. Tata McGraw-Hill.
3.	Advanced Structural Analysis	Menon, D., CBS Publishers & Distributors Pvt. Ltd.
4.	Structural Analysis	Menon, D, Narosa Publishing House.
5.	Elementary Structural Analysis	Ashok, K. Jain, Nem Chand & Bros
6.	Advanced Structural Analysis with Finite Element Method	Ashok, K. Jain , Nem Chand & Bros
7.	Mechanics of Structures Vol. II (Theory and Analysis of Structures	Junnarkar, S. B., and Shah, H. J. Charotar Publishing House Pvt. Ltd.
8.	Basic Structural Analysis	Reddy, C. S, Tata McGraw Hill
9.	Intermediate Structural Analysis	Wang, C. K, Tata McGraw Hill
10.	Structural Analysis	Hibbeler, R. C. Pearson Prentice Hall.

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	4th
COURSE TITLE	**Surveying - II**
COURSE CODE	CIV-251-C
COURSE CATEGORY	Professional Core Course (PCC)

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
3	2	1	0	0	45

COURSE OBJECTIVES	
1.	To impart a basic understanding of various aspects related to geodetic surveying and other measurements in Civil Engineering.
2.	To provide knowledge of Total Station & advanced surveying instruments.
3.	To develop skills to set out Curves in the field using both Total Station and Theodolite.

COURSE CONTENT		
Units	**Description**	**Cont. Hours**
1.	Contouring - Methods - Characteristics, and uses of contours – Plotting – Methods of interpolating contours – Computations of cross-sectional areas and volumes	9
2.	Theodolite - Types - Description - Horizontal and vertical angles - Temporary and permanent adjustments – Heights and distances– Tangential and Stadia Tachometry –Sub tense method - Stadia constants	9
3.	Horizontal and vertical control, baseline, corrections, satellite stations, reduction to center, trigonometrical levelling, single and reciprocal observations.	9
4.	Errors, Sources, precautions, and corrections, classification of errors, true and most probable values, weighed observations, the principle of least squares, normal-equation.	9
5.	Classifications of total station: Electro-optical system, Working principle, Infrared and Laser Total Station instruments. Microwave system working principle, Microwave Total Station instruments. Comparison between Electro-optical and Microwave Systems. Care and maintenance of Total Station instruments.	9

COURSE OUTCOMES	
CO 1.	Graduates will have a comprehensive understanding of geodetic surveying, including geodetic datum
CO 2.	Students will be adept at integrating cutting-edge technologies, such as advanced GPS, and other digital mapping tools, for precise and detailed survey data collection and analysis.
CO 3.	Graduates will demonstrate the ability to process and analyze complex survey data, utilizing statistical methods
CO 4.	Students will be equipped with the skills to manage and lead advanced surveying projects, including planning, executing, and overseeing complex surveying tasks in diverse fields such as construction, environmental management, and urban planning.

TEXT BOOKS/REFERENCES		
S. No	**Book/Text Title**	**Author**
1.	Surveying (volume 2)	Dr. K. R. Arora
2.	Surveying (volume II)	S.K Duggal
3.	Surveying (volume II)	B. C Punima

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	4th
COURSE TITLE	**Fluid Mechanics-II**
COURSE CODE	CIV-252-C
COURSE CATEGORY	Professional Core Course (PCC)

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
3	2	1	0	0	45

COURSE OBJECTIVES	
1.	To develop the understanding of basic principles of fluid flow through pressure and gravity type conduit systems.
2.	To gain proficiency in applying the conservation equations to open channel flow problems.
3.	To develop and apply relationships for hydraulic jumps, surges, and critical, uniform and gradually-varying flows.
4.	To determine the losses in a flow system, flow through pipes, boundary layer flow and flow past immersed bodies.

COURSE CONTENT		
Units	**Description**	**Cont. Hours**
1.	**Boundary Layer Theory** Concept of boundary layer; Laminar and turbulent boundary layers; boundary layer thickness; von Karman integral equation; Laminar sub layer; hydro-dynamically smooth and rough boundaries, Separation of flow and its control, Cavitation.	**10**
2.	**Flow In Open Channels** Classification of flow in channels, Steady and unsteady flow, Uniform and non-uniform flow, Laminar and turbulent flow, Sub-critical, critical and super-critical flow; Discharge through open channel by Chezy's formula; Most economic section of channels; Specific energy and specific energy curve; Hydraulic jump; Gradually varied flow.	**10**
3.	**Flow Through Pipes, Water Hammer and Surge Tanks** Loss of energy in pipes, Major and minor losses, Loss due to sudden enlargement & contraction; Hydraulic gradient & total energy line; Flow through compound pipes, Equivalent pipes, Flow through parallel pipes, Flow through branched pipes; Power transmission through pipes; Water hammer in pipes, Gradual closure of valve, Sudden closure of valve in rigid pipe, Sudden closure of valve in elastic pipe, Surge tanks, Location of Surge tank and types of surge tanks.	**09**

4.	**Fluid Flow Past Submerged Bodies** Forces exerted by a flowing fluid on a stationary body, Drag and lift; Drag on sphere, Terminal velocity, Drag on a cylinder; Lift development on a circular cylinder, Flow of ideal fluid over stationary cylinder, Expression for lift forces acting on Rotating cylinder, Magnus effect	**08**
5.	**Hydraulic Machines** Types of Turbines, Description and principles of impulse and reaction Turbines, Turbine characteristics, Selection of Turbines; Unit quantities and specific speed, Runaway speed, Cavitation; Draft tube, Draft tube dimensions, Types of Draft tubes; Centrifugal pumps, specific speed power requirements, Reciprocating pumps.	**08**

COURSE OUTCOMES	
CO 1.	Analyze and perform calculations on open channel flows, compute water surface profiles and hydraulic jump characteristics
CO 2.	Analyze and perform calculations on pipe flow problems involving turbulent flow, understand the concept of friction factor, head loss, and design of pipes and analysis of Pipe-networks.
CO 3.	Perform calculations for determination of the drag and lift forces on submerged bodies.
CO 4.	Analyze water hammer phenomenon in closed conduits and concept of surge tanks.
CO 5.	Determine various hydraulic characteristics of turbines and pumps.

TEXT BOOKS/REFERENCES		
S. No	**Book/Text Title**	**Author**
1.	Fluid Mechanics and Fluid Power Engineering	Kumar, D.S.
2.	Engineering Fluid Mechanics	Garde R.J.
3.	Fluid Flow in Pipes & Channels	Asawa, GL,
4.	Engineering Fluid Mechanics	Kumar, K.L.
5.	Introduction to Fluid Mechanics and Fluid Machines	Som, S.K. and Biswas, G.

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	4th
COURSE TITLE	**Civil Engineering Construction & Architectural Drawing**
COURSE CODE	CIV-253-C
COURSE CATEGORY	Professional Core Course (PCC)

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
3	2	1	0	0	45

COURSE OBJECTIVES	
1.	Understand architectural design principles and their integration in civil engineering.
2.	Learn technical drawing skills for residential, institutional, and public buildings.
3.	Develop proficiency in RCC structural drawings including slabs, beams, columns, staircases, and bar bending schedules.
4.	Analyze and design climate-responsive roofing systems, especially for cold regions like Kashmir.
5.	Gain skills in road and basic bridge drawing, including alignment, profiles, and structural components.

COURSE CONTENT		
Units	**Description**	**Cont. Hours**
1.	Architectural Drawing Fundamentals: - Introduction to architecture and its relevance in civil engineering - Principles of architectural design: symmetry, rhythm, scale - NBC building bye-laws and climatic considerations - Building materials for function and aesthetics - Aesthetics in civil projects	8
2.	Building Drawing: - Drawing conventions (IS:962): symbols, scales, line types - Representation of walls, doors, windows, roofs - Planning and drawing of residential and public buildings - Elevation and section drawings	8
3.	RCC Drawing: - RCC drawing standards and symbols - Foundation types: isolated, combined footings - Column and beam detailing with reinforcement - Slab detailing (one-way, two-way), staircase reinforcement - Framing plans, G.A. plans, bar bending schedule (BBS) - Retaining wall (cantilever) drawing	9
4.	Roof Drawing: - Climatic needs of Kashmir: snow load, insulation	10

	- Traditional Roofing - Comparative study of flat vs pitched roofs	
5.	Road and Bridge Drawing: - Road drawing symbols, L-section, RL plotting - Road intersection layouts (T/Y, rotaries), Basic Sketch	10

COURSE OUTCOMES	
CO 1.	Interpret and apply architectural and civil drawing standards in design
CO 2.	Prepare and read technical drawings for civil structures
CO 3.	Create detailed building drawings with accurate spatial layouts
CO 4.	Design climate-appropriate roofs and understand traditional roofing systems
CO 5.	Develop drawings for road alignments and simple RCC bridge components

TEXT BOOKS/REFERENCES		
S. No	**Book/Text Title**	**Author**
1.	Building Drawing	M.G.Shah
2.	Civil Engineering Drawing	Chakorbarty
3.	Civil Engineering Drawing	J.B.Mckay
4.	Building Drawing	V.B.Sikka

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	4th
COURSE TITLE	**Sustainable Practices in Indian Knowledge System**
COURSE CODE	CIV-254-C
COURSE CATEGORY	Indian Knowledge System (Core)

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
1	1	0	0	0	15

COURSE OBJECTIVES	
1.	To introduce the students to the concept of sustainability rooted in Indian traditional knowledge systems, especially in the context of environmental ethics and civil engineering.
2.	To make students aware of practical and sustainable civil engineering practices found in ancient India, linking them with contemporary environmental solutions.

COURSE CONTENT		
Units	**Description**	**Cont. Hours**
1.	**Philosophical and Ethical Foundations of Sustainability in Indian Knowledge System** • Concept of "Dharma" and sustainability in Indian scriptures (Vedas, Upanishads, and Puranas). • Role of nature and environment in Indian philosophy – Panchamahabhutas (Five elements). • Traditional Indian approach to water conservation, forestry, agriculture, and urban planning. • Eco-centric vs anthropocentric worldviews and its implications on civil engineering. • Case study: Ancient water management systems such as step wells, tanks, and canals.	**8**
2.	**Traditional Practices and their Modern Relevance in Civil Engineering** • Traditional Indian building materials – Lime, mud, bamboo, stone; ecological benefits and durability. • Vernacular architecture and climate-responsive design principles. • Low-cost housing techniques and sustainable rural infrastructure.	**7**

	• Riverfront and watershed management in ancient India and its contemporary adaptation. • Integration of cultural, spiritual, and ecological values into modern engineering design	

COURSE OUTCOMES	
CO 1.	Understand and articulate the philosophical basis of sustainable practices in Indian culture and relate them to civil engineering challenges.
CO 2.	Apply ancient sustainable practices in modern infrastructure and urban planning with a focus on environmental consciousness.

TEXT BOOKS/REFERENCES		
S. No	**Book/Text Title**	**Author**
1.	Indian Knowledge Systems	Kapil Kapoor
2.	Sustainable Civil Engineering Practices	Suresh Chand
3.	Cultural Heritage and Sustainable Development	Anuradha Mukherjee
4.	Vastu Shastra: The Ancient Science of Architecture	B. B. Puri
5.	Water Architecture in South Asia	Julia Hegewald

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	4th
COURSE TITLE	**Structure Lab-II**
COURSE CODE	CIV-266-C
COURSE CATEGORY	Professional Core Course (PCC)

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
1	0	0	2	0	30

COURSE OBJECTIVES	
1.	To experimentally investigate the deformation and load-carrying behavior of structural elements such as beams, trusses, arches, and frames.
2.	To verify classical theorems of structural analysis like Maxwell's theorem and assess influence lines in statically determinate structures.
3.	To understand the concept of structural redundancy and elastic coupling in structural systems.

COURSE CONTENT		
Units	**Experiments**	**Cont. Hours**
1.	Deflection of curved beams.	**4**
2.	Behavior of Portal Frame under different load combinations.	**3**
3.	Deflection of Truss.	**3**
4.	Behavior of a cantilever beam under symmetrical and unsymmetrical loading.	**4**
5.	Analysis of an elastically coupled beam.	**3**
6.	Analysis of a redundant joint.	**3**
7.	Analysis of two hinged arches.	**3**
8.	Verification of Maxwell's Theorem.	**3**
9.	Verification of Horizontal Thrust in a 3-Hinged Arch.	**4**

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	4th
COURSE TITLE	**Surveying Lab-II**
COURSE CODE	CIV-267-C
COURSE CATEGORY	Professional Core Course (PCC)

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
1	0	0	2	0	30

COURSE OBJECTIVES	
1.	Measure Horizontal and vertical angles using Theodolite
2.	Measure height of buildings using theodolite and Tachometer
3.	Measure horizontal and vertical distances using Tachometry,
4.	Setting out of works
5.	Measure horizontal/vertical distances, horizontal/vertical angles, and area of sites

COURSE CONTENT		
Units	**Experiments**	**Cont. Hours**
1.	Contouring by Different Methods	**5**
2.	Study of Theodolite	**3**
3.	Measurement of horizontal angles by reiteration and repetition and vertical angles.	**3**
4.	Theodolite survey traverse.	**4**
5.	Heights and distances - Triangulation - Single plane method.	**3**
6.	Tachometry - Tangential system - Stadia system - Sub tense system.	**3**
7.	Setting out works - Foundation marking - Simple curve (right/left handed) Transition curve.	**5**
8.	Measurement of Horizontal and Vertical distance using Total Station.	**4**

COURSE OUTCOMES	
CO 1.	To handle and use Theodolite for measurement of horizontal angles & vertical angles.
CO 2.	To layout different types of traverses using Theodolite.
CO 3.	To handle and use Tacheometer
CO 4.	To set out works- Foundation markings, simple curves, and Transition curves.
CO 5.	To handle and use Total station for measurement of horizontal/vertical distances, traversing, and area calculation.

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	4th
COURSE TITLE	**Fluid Mechanics Lab-II**
COURSE CODE	CIV-268-C
COURSE CATEGORY	Professional Core Course (PCC)

CREDITS AND CONTACT HOURS

CREDITS	L	T	P	S	TOTAL NO. OF CONTACT HOURS
1	0	0	2	0	30

COURSE OBJECTIVES	
1.	To compare the results of analytical models introduced in lecture to the actual behaviour of real fluid flow.
2.	To discuss and practice standard measurement techniques of fluid mechanics and their applications.
3.	To learn and practice writing technical reports
4.	To work on small design projects.

COURSE CONTENT

Units	Experiments	Cont. Hours
1.	To find friction factors for pipes of different materials.	**5**
2.	To determine the minor head loss coefficient for different pipe fittings.	**5**
3.	To determine the surface profile and total head distribution of a vortex.	**5**
4.	To determine the elements of hydraulic jump in a rectangular channel.	**5**
5.	To determine the Manning's rugosity coefficient of a laboratory flume.	**5**
6.	To obtain the velocity distribution for an open channel and to determine the values of α and β (correction factors).	**5**

COURSE OUTCOMES	
CO 1.	Utilize basic measurement techniques of fluid mechanics
CO 2.	Discuss the differences among measurement techniques
CO 3.	Identify, name, and characterize flow patterns and regimes
CO 4.	Understand basic units of measurement, convert units, and appreciate their magnitudes
CO 5.	Demonstrate a practical understanding of friction losses in internal flows

TEXT BOOKS/REFERENCES

S. No	Book/Text Title	Author
1.	"Fluid Mechanics with Laboratory Manual," Prentice Hall India Learning Private Limited, January 2010.	Bireswar Majumdar,
2.	"Fluid Mechanics & Machinery Laboratory Manual,", Charotar Books Dist.-Anand; 1st Edition, January 2014.	Dr. N. Kumara Swamy

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	4th
COURSE TITLE	**Computer Based Drafting Lab**
COURSE CODE	CIV-269-C
COURSE CATEGORY	Professional Core Course (PCC)

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
1	0	0	2	0	30

COURSE OBJECTIVES	
1.	To learn how to deal with the different AutoCAD Windows and their contents.
2.	To gain knowledge in drawing of various building components and structural drawings of a building.
3.	To obtain knowledge of modelling of various building components and special sections of a building.
4.	To become aware of different modelling, drafting, analysis, and design software.

COURSE CONTENT		
Units	**Topic**	**Cont. Hours**
1.	**Introduction to Computer Aided Drawing:** Introduction, Auto- Cadd Window, Starting, Opening and Saving a Drawing, Prototype Drawing and closing of drawing. Different forms of Projections and plotting in Cadd, Geometrical construction in Cadd.	**6**
2.	**Software For Cad And Practice Exercises On Cad:** Drawing cross sections (I, C, T, angles, solid and hollow sections), To draw horizontal and vertical lines keep ortho on; To draw inclined lines keep the ortho off; Draw the alphabets as per the given dimensions. Practice exercises on simple drawing areas and sections, surfaces, etc.	**6**
3.	**Drawing of Plans of Buildings:** Development of Working of Building. Drawing of different plans for single and Multi-storey Buildings; Drawing in different layouts. Reinforcement detailing's and structural drawings.	**6**
4.	**Drawing Of Sections And Elevations Of Buildings:** Drawing of different sections and elevations of buildings. Drawing of single and multi- storey buildings, their sections, and their elevations. Reinforcement detailing's and structural drawings. 3D drafting of Building.	**6**

5.	**Drawing Of Building Components:** Detailing of Building components like Doors, Windows, Ventilator, Lift, Stairs, Elevators. Drawing of Plumbing and electrical drawings of buildings.	**6**

COURSE OUTCOMES	
CO 1.	Recognizing the need for computer aided drafting of buildings.
CO 2.	Understanding the method of Drafting in CAD and drafting 2D and 3D visualizations
CO 3.	Gaining skill based knowledge of drafting tools.

TEXT BOOKS/REFERENCES		
S. No	**Book/Text Title**	**Author**
1.	"Engineering Drawing + AutoCAD," New Age International Publishers, 2011	K.Venugopal V. Prabhu Raja
2.	"Introduction to AutoCAD 2015 for Civil Engineering Applications", SDC Publishers, 2014.	Nighat Yasmin
3.	"Exploring AutoCAD Civil 3D 2018", CADCIM, 2018.	Sham Tickoo

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	4th
COURSE TITLE	**Survey Camp**
COURSE CODE	CIV-270-C
COURSE CATEGORY	Professional Core Course (PCC)

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
1	0	0	2	0	30

Survey Camp using modern survey equipment e.g., Total Station etc-. The camp must involve work in a large area. At the end of the camp, each student must have mapped and contoured the area. The camp record shall include all original field observations, calculations, and plot. The Workshop will be conducted for every batch once in the degree it will be completed in 10 working days or equal hours.

COURSE OBJECTIVES	
1.	To impart intensive training in the use of surveying instruments
2.	To train the students to appreciate practical difficulties in surveying on the field
3.	Making the students conversant with the camp life
4.	Training the students to communicate with the local population
5.	Providing an opportunity to the students to develop team spirit
6.	To train the students for self-management

COURSE CONTENT		
Units	**Description**	**Cont. Hours**
1.	Module 1: Introduction to survey, types of survey, the importance of survey in the field.	**3**
2.	Module 2: Exposure to different types of survey projects carried out in the present day industry.	**3**
3.	Module 3: introduction of leveling and handling of the total station.	**4**
4.	Module 4: Methods of data collection using a total station.	**3**
5.	Module 5: Methods to provide control points.	**3**
6.	Module 6: Preparation of site plan and layout.	**3**
7.	Module 7: Prepare L-Section and C-Section of the road not less than 3 Km	**4**
8.	Module 8: Preparation of contour plan of land not less than 30 Kanal.	**4**
9.	Module 9: Hand on practical session on plotting and mapping by using the software Module10: Report making.	**3**

COURSE OUTCOMES	
CO 1.	Interpret the contours.
CO 2.	Work in teamwork.
CO 3.	Mark a road alignment of (L-section, Cross-section) a given gradient connecting any two stations on the map
CO 4.	Calculate the earthwork
CO 5.	Prepare a topographical plan of a given area.

CERTIFICATION	
Certification will be issues only after;	
1.	Fulfilling Attendance Criteria i.e. it's compulsory to achieve 100% attendance in the Workshop.
2.	Certificate of Moral Ethics during workshop issued by coordinator program.
3.	Passing the Assessment.
ASSESSMENT	
Assessment Will Consist Of;	
1.	Practical work
2.	Report Writing
3.	Presentation
4.	Drawing
5.	Viva-voce
BEST PERFORMANCE AWARD	
NOTE: Best performance award will be given on the bases of overall performance of students in the Camp.	

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	5th
COURSE TITLE	**Design of Concrete Structures-I**
COURSE CODE	CIV-301-C
COURSE CATEGORY	Professional Core Course (PCC)

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
3	2	1	0	0	45

COURSE OBJECTIVES	
1.	To equip students with a basic understanding of the behavior of reinforced concrete (RC) structures and to develop the skill to analyze and design reinforced concrete members.

COURSE CONTENT		
Units	**Description**	**Cont. Hours**
1.	Working Stress Method vs. Limit State Design. Principles of ultimate load design and load factors.	**4**
2.	Flexural design: balanced and under-reinforced sections. Shear design and detailing. Design examples for singly and doubly reinforced beams. L and T beams.	**5**
3.	One-way and two-way slabs: flexural and shear design. Detailing of slab reinforcements.	**12**
4.	Axially loaded columns: short and slender columns. Design examples for different shapes of column designs.	**12**
5.	Detailing and durability considerations in design of columns, beams and slabs. Design of connections and anchorage and development lengths	**12**

COURSE OUTCOMES	
CO 1.	Understanding of reinforced concrete as a construction material and various design philosophies & their differences.
CO 2.	Analyze and design RC members under flexure, shear, and axial force in line with Indian standards.
CO 3.	Design the two-way RC slabs using moment coefficients.

TEXT BOOKS/REFERENCES		
S. No	**Book/Text Title**	**Author**
1.	Structural Analysis	Hibbeler, R. C. Pearson Prentice Hall.
2.	Fundamentals of Structural Analysis	Leet, K. M., and Uang, C. M. Tata McGraw-Hill.
3.	Advanced Structural Analysis	Menon, D., CBS Publishers & Distributors Pvt. Ltd.
4.	Structural Analysis	Menon, D, Narosa Publishing House.
5.	Elementary Structural Analysis	Ashok, K. Jain, Nem Chand & Bros
6.	Advanced Structural Analysis with Finite Element Method	Ashok, K. Jain , Nem Chand & Bros
7.	Mechanics of Structures Vol. II (Theory and Analysis of Structures	Junnarkar, S. B., and Shah, H. J. Charotar Publishing House Pvt. Ltd.
8.	Basic Structural Analysis	Reddy, C. S, Tata McGraw Hill
9.	Intermediate Structural Analysis	Wang, C. K, Tata McGraw Hill

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	5th
COURSE TITLE	**Geotechnical Engineering-I**
COURSE CODE	CIV-302-C
COURSE CATEGORY	Professional Core Course (PCC)

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
3	2	1	0	0	45

COURSE OBJECTIVES	
2.	To develop basic understanding of soils.
3.	To understand flow of water through soils.
4.	To understand soil compressibility characteristics.
5.	To understand different kind of stresses in soils.
6.	To understand soil investigation.

COURSE CONTENT		
Units	**Description**	**Cont. Hours**
1.	Introduction: Soil and its formation, various processes and agencies for formation, Types of Soils. Basic definitions. Relations and interrelations, Three phase soil Model, Index properties, classification of soils (USCS & ISCS)	**10**
2.	Soil Hydraulics: Flow-through soils, Darcy's Law. Permeability and factors affecting permeability and determination in the lab/Field. Steadystate Flow, seepage force, Laplace equation for steady- state flow, flow nets for homogenous embankments with & without toe filters.	**07**
3.	Soil Compressibility: One Dimensional Consolidation, Terzaghi's equation. Consolidation test, e log p curves. Consolidation settlement, time required for settlement. Compaction, laboratory compaction tests, proctor compaction, compaction curve, and control on field compaction.	**10**
4.	Effective Stress & Stress Distribution: Total & effective stresses, Pore Water pressure, Stress distribution under concentrated load. Boussineq's method	**08**

5.	Soil Investigation & Clay Mineralogy: Laboratory & Field Investigation. Basic definitions, Sub-soil exploration, Standard Penetration methods, (SPT&SCPT) Geo-Physical methods, Minerals Present in clay. Dependence of behavior of clay on type of mineral.	**10**

COURSE OUTCOMES	
CO 1.	To classify soils and understand their index properties.
CO 2.	To analyze flow through soils.
CO 3.	To perform/demonstrate soil compaction tests
CO 4.	To determine stress distribution in soils.
CO 5.	To utilize various methods of soil investigation in field and laboratory

TEXT BOOKS/REFERENCES		
S. No	**Book/Text Title**	**Author**
1.	Soil Mechanics and Foundation Engineering	K.R.Arora
2.	Soil Mechanics and Foundation Engineering	S.K.Garg
3.	Theoretical Soil Mechanics	Terzaghi & Peck
4.	Soil Mechanics	S.B. Saighal
5.	Geotechnical Engineering	C.Venkataramiah

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	5th
COURSE TITLE	**Water Supply Engineering**
COURSE CODE	CIV-303-C
COURSE CATEGORY	Professional Core Course (PCC)

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
3	2	1	0	0	45

COURSE OBJECTIVES	
1.	To impart understanding of various aspects related to supply of pure and safe drinking water to communities and the conservation of water.
2.	To make technology choice to deal with water quality issues, operate and maintain working treatment systems and do troubleshooting of the problems in these systems.
3.	To design, construct, operate and maintain water conveyance system.
4.	To acquire sufficient knowledge on basic design of conventional and advanced water treatment processes.

COURSE CONTENT		
Units	**Description**	**Cont. Hours**
1.	**Water Quality:** Introduction and scope, Various sources of water, Water Quality Parameters, significance and codal recommendations of limits for various uses. Physical, chemical and biological characteristics, water demand, per capita demand.	**09**
2.	**Water Consumption And Water Distribution:** Water Consumption for various uses, variation in Demand & Supply. Population forecasting methods, storage capacities of reservoirs, Systems of distribution, distribution networks.	**12**
3.	**Water Transportation:** Pipe designs, network analysis by various methods, pipe materials and joints, leakage prevention.	**09**
4.	**Treatment Process:** Water treatment: Conventional treatments like screening, sedimentation, Coagulation, Filtration, Disinfection. Advanced treatments like Ozonation and Activated carbon adsorption, etc.	**10**
5.	**Sanitation:** Water supply in buildings, Plumbing and fixtures, Sanitation of buildings.	**5**

CO 1.	Select appropriate treatment to raw water useful for domestic as well as construction purpose.
CO 2.	Maintain the pipe-network for water supply system effectively.
CO 3.	Calculate and Estimate the impurities present in water used for domestic as well as construction works.
CO 4.	Prepare lay out plan and maintain water distribution and sewer-networks.
CO 5.	Test raw water as per the standard practices

TEXT BOOKS/REFERENCES		
S. No	**Book/Text Title**	**Author**
1.	Water Supply and Sanitary Engineering	S.K.Hussain
2.	Water and Wastewater Technology	Hammer, M.J.
3.	Introduction to Environmental Engineering	Davis, M.L. and Cornwell, D.A.,
4.	Water Supply And Sanitary Engineering	Rangwala
5.	Water Supply and Sanitary Engineering	S.K.Garg
E-REFERENCES		
6.	https://archive.nptel.ac.in/courses/105/105/105105201	
7.	https://onlinecourses.nptel.ac.in/noc20_ce23/preview	
8.	https://www.edx.org/learn/engineering/purdue-university-analysis-and-design-ofwater-distribution-systems	

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	5th
COURSE TITLE	**Concrete Technology**
COURSE CODE	CIV-304-C
COURSE CATEGORY	Professional Core Course (PCC)

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
3	2	1	0	0	45

COURSE OBJECTIVES	
1.	**To impart knowledge of concrete materials and their properties** – Understand the role of cement, aggregates, water, and admixtures in concrete production and performance.
2.	**To develop skills in concrete mix design and testing** – Learn proportioning methods, workability assessment, strength evaluation, and non-destructive testing techniques.
3.	**To Enable evaluation and quality control of concrete** through standard testing methods and interpretation of results to ensure structural safety, durability, and sustainability in construction practice.

COURSE CONTENT		
Units	**Description**	**Cont. Hours**
1.	Concrete as a construction material, constituents of concrete. Properties of concrete materials: cement, aggregates, water, admixtures. Hydration of cement: setting, hardening, and strength development.	**08**
2.	Principles of concrete mix design: factors influencing mix proportions. Proportioning of concrete mixes for desired strength and workability. Special concrete mixes: lightweight, high-strength, self-compacting concrete.	**12**
3.	Properties of Fresh and Hardened Concrete - Workability, segregation, bleeding, setting time, strength development. Factors affecting properties and performance. Curing of concrete and its importance.	**08**
4.	Testing of Fresh and Hardened Concrete - Tests for workability: slump, compaction factor, flow. Tests for compressive strength, tensile strength, and durability. Non-destructive testing methods for concrete evaluation.	**09**

5.	Durability aspects, fiber-reinforced concrete, sustainability in concrete production, advanced concrete technologies and their applications	**08**

COURSE OUTCOMES	
CO 1.	Explain the properties and role of cement, aggregates, water, and admixtures in concrete.
CO 2.	Apply mix design principles for strength, workability, and special concretes.
CO 3.	Evaluate workability, setting, strength, and curing effects.
CO 4.	Perform and interpret fresh and hardened concrete tests.
CO 5.	Understand durability, fiber-reinforced, and sustainable concrete technologies.

TEXT BOOKS/REFERENCES		
S. No	**Book/Text Title**	**Author**
1.	Properties of Concrete	Neville, A.M. Pearson Publishers, New Delhi, 2004
2.	Concrete Technology	Shetty, M.S. S.Chand& Company New Delhi, 2002,
3.	Concrete Technology	Gambhir,M.L. TaTa McGraw Hill New Delhi, 1995
4.	Concrete Technology	Neville, A.M. and Brookes, J.J, Pearson. 1994
5.	Properties of Concrete	Neville, A.M. Pearson Publishers, New Delhi, 2004
6.	IS 456:2000 – Plain and Reinforced Concrete – Code of Practice.	BIS
7.	IS 10262:2019 – Concrete Mix Proportioning – Guidelines.	BIS

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	5th
COURSE TITLE	**Quantity Survey and Cost Estimation**
COURSE CODE	CIV-305-C
COURSE CATEGORY	Professional Core Course (PCC)

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
3	2	1	0	0	45

COURSE OBJECTIVES	
1.	To produce a forecast of the probable cost of a future project
2.	Identify and prioritize cost-saving opportunities.
3.	To determine the true (full) costs of each item of the project
4.	To evaluate the target of road construction project
5.	To assess and evaluate the differences in the value of the assets.

COURSE CONTENT		
Units	**Description**	**Cont. Hours**
1.	**Introduction to Estimation.** Definition and importance of Quantity Surveying and Cost estimation Definition of items of a work and their units. Data required for the preparation of an estimate. Types of preliminary Estimate and Detailed estimate. Forms used in estimating.	**7**
2.	**Analysis of Rates.** Definition and importance of analyses of rates. Introduction to Preparing of rates, Labor schedule, material schedule, and rate schedule. Analysis of rates for item of work of buildings e.g., Earthwork in the foundation, lime concrete in Foundation, concrete in foundation and superstructure, Brickwork in foundation and superstructure, stone masonry, RCC masonry, RCC work, Plastering, color washing, woodwork, DPC, and steelwork, etc.	**7**
3.	**Detailed Estimation of masonry structures.** Introduction to estimates of different types of buildings. Estimates of walls. Methods of building estimate; Long wall and short wall method, centerline methods. Estimate of masonry platform. Estimate of a masonry tank. Estimate of a single room building. Estimate of two room building with CGI roof over wooden	**11**
4.	**Detailed Estimates of R.C.C Structures.** Estimation of R.C.C slabs: One-way slab, Two-way slab. Estimate of a RCC Beams: Simply supported Beam, cantilever beam, lintel Beam. RCC Column. Bar bending schedule.	**10**

5.	**Estimation of Roads.**	**10**
	Methods of estimating earthwork: (a) Mid Sectional Area Method.(b) Mean Sectional Area Method(c) Prismoidal Formula Method. (d) Graphical Method. Estimate of a metallic road: Estimation of 3-layer metallic road .introduction about influence of Material variation and cost in layered metallic road.	

COURSE OUTCOMES	
CO 1.	Give the Students a reasonable idea of the project's cost to help them decide whether the work can be undertaken as proposed or not.
CO 2.	Learner should be capable enough to analyze the project resources.
CO 3.	Learner should be able to make DPR of buildings.
CO 4.	Learner should know the cost variation due to material change in road construction.
CO 5.	Learner should assess and calculates the property value.

TEXT BOOKS/REFERENCES		
S. No	**Book/Text Title**	**Author**
1.	Estimating & Costing	Datta.
2.	Estimating & Costing	Mahajan.
3.	Cost Estimation: Methods and Tools.	Gregory K. Mislick, Daniel A. Nussbaum.
4.	Civil Estimating and Costing	A.K.Upadhyay.

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	5th
COURSE TITLE	**Geotechnical Engineering Lab-I**
COURSE CODE	CIV-316-C
COURSE CATEGORY	Professional Core Course (PCC)

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
1	0	0	2	0	30

COURSE OBJECTIVES	
1.	To understand the laboratory tests used for the determination of physical, index, and Engineering properties of soil

COURSE CONTENT		
Units	**Experiments**	**Cont. Hours**
1.	Soil Identification Tests	**3**
2.	Water Content Determination Test	**3**
3.	Field Density Measurement	**3**
4.	Specific Gravity Test	**4**
5.	Sieve Analysis Test	**3**
6.	Sedimentation Analysis Test	**3**
7.	Atterberg and Shrinkage Limits	**3**
8.	IS Light Heavy Compaction Tests	**4**
9.	Permeability Tests	**4**

COURSE OUTCOMES	
CO 1.	To determine basic soil properties and consistency limits.
CO 2.	Draw the complete particle size distribution curve of a given soil.
CO 3.	Determine the Compaction characteristic of a given soil.
CO 4.	Determine the Permeability of any given soil specimen

TEXT BOOKS/REFERENCES		
S. No	**Book/Text Title**	**Author**
1.	IS codes relevant to each Test.	IS Codes
2.	Geotechnical Engineering, New Age International publishers, 2012.	C. Venkatramaiah
3.	Basic and Applied Soil Mechanics, New Age International Publishers, 2012	Gopal Ranjan and A. S. R. Rao,
4.	Soil Mechanics and Foundation Engineering, Standard Publishers, 2011.	K. R. Arora,

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	5th
COURSE TITLE	**Environmental Engineering Lab**
COURSE CODE	CIV-317-C
COURSE CATEGORY	Professional Core Course (PCC)

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
1	0	0	2	0	30

COURSE OBJECTIVES	
1.	To introduce students to how the standard environmental experiments relating to water and wastewater quality are performed.
2.	To know which tests are appropriate for given environmental problems, statistically interpret laboratorial results and write technical reports, and apply the laboratorial results to problem identification, quantification, and basic environmental design and technical solutions.
3.	To Understand how to classify and analyze various quality parameters of raw water.
4.	To make the students as to suggest a required type of treatment to purify raw water
5.	To make the students as analysts to differ quality requirements for industrial waters and domestic waters.

COURSE CONTENT		
Units	**Experiments**	**Cont. Hours**
1.	To measure the dissolved oxygen concentration of a water sample.	**2**
2.	To determine the pH of the given wastewater sample	**2**
3.	To determine the turbidity of the given sample of wastewater using nephelo turbidity meter.	**3**
4.	Determination of Total, Suspended and Dissolved Solids in a given water sample.	**3**
5.	Determination of Alkalinity of a given water sample.	**2**
6.	Determination of Chlorides of a given water sample.	**3**
7.	Determination of Acidity of a given water sample.	**2**
8.	Determination of Total Hardness (Soda-Reagent Method.) of a given water sample.	**3**
9.	Determination of Colour/Odour of a given water sample.	**3**
10.	Determination of Dissolved Oxygen content of a given water sample.	**2**
11.	Determination of C.O.D.	**2**
12.	Determination of optimum dose of coagulant	**3**

COURSE OUTCOMES	
CO 1.	Perform standard environmental experiments relating to water quality, and know which tests are appropriate for environmental problems.
CO 2.	Statistically analyze and interpret laboratory results.
CO 3.	Analyse various physico-chemical and biological parameters of water in case of quality requirements.
CO 4.	Understand and use the water and wastewater sampling procedures and sample preservations.
CO 5.	Demonstrate the ability to write clear technical laboratory reports

TEXT BOOKS/REFERENCES		
S. No	**Book/Text Title**	**Author**
1.	A text book of "Water supply Engineering", by Khanna publishers.	Santhosh Kumar Garg
2.	A text book of "Chemical analysis of water and soil", by Reem.	Dr. KVSG Murali Krishna
3.	"Practical Manual of Water Quality Analysis", Chemical Industry Press, January 2012.	ZU ZHI BIAN XIE
4.	"Laboratory Manual for the Examination of Water, Waste Water, and Soil," Wiley-VCH; 3 edition, January 2000.	Hans Hermann Rump

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	5th
COURSE TITLE	**Concrete Technology Lab**
COURSE CODE	CIV-318-C
COURSE CATEGORY	Professional Core Course (PCC)

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
1	0	0	2	0	30

COURSE OBJECTIVES	
1.	To know the concept and procedure of different types of tests conducted on cement, aggregate, and finished concrete.
2.	To understand the procedure of designing the concrete mix of given specification of its ingredients and appropriate water-cement ratio and admixtures.

COURSE CONTENT		
Units	**Experiments**	**Cont. Hours**
1.	**FINE AGGREGATES:** Grading and zoning of fine aggregates, Specific gravity of fine aggregates**.**	**4**
2.	**COARSE AGGREGATES:** Grading and zoning of Coarse aggregates. Determination of water absorption of coarse aggregates	**5**
3.	**CEMENT:** Determination of standard consistency of cement. , Determination of initial setting time and final setting time of cement, Determination of fineness of cement, Soundness test of concrete.	**5**
4.	**CONCRETE:** Determination of consistency of fresh concrete by slump test. Determination of workability of freshly mixed concrete by Compaction factor test. Determination of cube strength of concrete for different mixes and different W/C ratio Determination of tensile strength of concrete. Determination of flexural strength of concrete beam.	**16**

COURSE OUTCOMES	
CO 1.	Perform different tests conducted on cement, aggregate, and concrete at the site.
CO 2.	Perform a non-destructive test on concrete.
CO 3.	Design the concrete mix as per the site conditions and specification of materials available there.

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	6th
COURSE TITLE	**Design of Steel Structures**
COURSE CODE	CIV-350-C
COURSE CATEGORY	Professional Core Course (PCC)

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
3	2	1	0	0	45

COURSE OBJECTIVES	
1.	**Understand advanced steel design concepts** – Learn the principles of Working Stress and Limit State Design for steel structures.
2.	**Develop competency in designing structural members** – Analyze and design tension members, compression members, beams, and beam-columns considering stability and strength.
3.	**Master steel connection design** – Design bolted, welded, and moment connections for structural integrity and performance.

COURSE CONTENT		
Units	**Description**	**Cont. Hours**
1.	Introduction to advanced design concepts for steel structures. Working Stress Method vs. Limit State Design for steel structures.	**09**
2.	Design of tension members: Types of tension members and loading conditions. Design for axial tension and net area. Block shear rupture and yielding.	**09**
3.	Types of compression members and loading conditions. Euler's buckling formula and effective length. Interaction formula for combined axial and flexural loading. Design of laterally supported beams.	**09**
4.	Types of steel connections: bolted, welded, and composite. Design of bolted and welded connections. Eccentrically loaded and moment connections.	**09**
5.	Design of laterally unsupported beams and design of beam-columns.	**09**

COURSE OUTCOMES	
CO 1.	**Understand steel design principles** – Explain the concepts of Working Stress and Limit State Design for steel structures.
CO 2.	**Analyze and design tension members** – Determine net area, block shear rupture, and yielding criteria for axial tension members.
CO 3.	**Design compression members and beams** – Apply Euler's buckling formula and interaction formulas to design stable compression members and beams.
CO 4.	**Evaluate and design steel connections** – Design bolted, welded, and eccentric connections for structural stability.
CO 5.	**Design complex steel structural elements** – Develop solutions for laterally unsupported beams and beam-columns under combined loading.

TEXT BOOKS/REFERENCES		
S. No	**Book/Text Title**	**Author**
1.	Design of Steel Structures – Limit States Method	Subramanian, N. Oxford University Press.
2.	Design of Steel Structure	Duggal, S. K. Tata McGraw Hill.
3.	Steel Structures – Design & Behaviour	Salmon, C. G., Johnson, J. E., and Malhas, F. A., Pearson
4.	Design and Analysis of Steel Structures	Vizrani, V. N., Ratwani, M. M., and Kumar, V. Khanna Publishers.

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	6th
COURSE TITLE	**Geotechnical Engineering-II**
COURSE CODE	CIV-351-C
COURSE CATEGORY	Professional Core Course (PCC)

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
3	2	1	0	0	45

COURSE OBJECTIVES	
1.	To understand shear strength of soil along with the different tests to evaluate it.
2.	To understand the basic equations for bearing capacity analysis of soils.
3.	To understand basic theories for earth pressure calculations.
4.	To understand the different soil stabilization methods.
5.	To understand the different theories for slope stability analysis of soils.

COURSE CONTENT		
Units	**Description**	**Cont. Hours**
1.	**Shear Strength:** Shear strength concept. Mohr Coulomb equation. Direct shear test, Triaxial compression test under different drainage conditions, CD, CU and UU. Unconfined compression test. Vane shear test. Modified shear strength envelope.	**10**
2.	**Bearing Capacity And Foundations:** Basic definitions, Terzaghi's solution for ultimate bearing capacity. Size effects and water table effect effects on bearing capacity. Skemptons bearing capacity equation. Plate load test. Design principles for footing and rafts, Pile foundation types, classification and determination of load-carrying capacity, dynamic and static methods. Pile load test, pile groups efficiency of pile groups.	**10**
3.	**Earth Pressure:** Lateral earth pressure, Rankine's theory for active and passive States. Lateral earth pressure under various conditions, like surcharge, sloping backfill, and high water table behind the wall. Earth pressure diagrams. Total thrust. Tension Cracks.	**10**
4.	**Stabilisation:** Methods of stabilization, Brief introduction to each of the methods of stabilization such as mechanical stabilization, Compaction Chemical stabilization, Precompression, Stone columns, stabilization by geotextiles.	**08**
5.	**Stability Of Slopes:** Infinite slopes, types of slope failures, stability number Swedish and Friction circle methods. Submergence case, complete drawdown case, Steady seepage case.	**07**

COURSE OUTCOMES	
CO 1.	To equip the knowledge of strength and mechanical behavior of soils.
CO 2.	To understand the concepts of bearing capacity and foundations.
CO 3.	To understand the practical aspects of earth pressure and retaining structures.
CO 4.	To understand the concepts of slope stability along with its practical application

TEXT BOOKS/REFERENCES		
S. No	**Book/Text Title**	**Author**
1.	Soil Mechanics and Foundation Engineering	K.R.Arora
2.	Soil Mechanics and Foundation Engineering	S.K.Garg
3.	Theoretical Soil Mechanics	Terzaghi & Peck
4.	Soil Mechanics	S.B. Saighal
5.	Geotechnical Engineering	C.Venkataramiah

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	6th
COURSE TITLE	**Transportation Engineering-I**
COURSE CODE	CIV-352-C
COURSE CATEGORY	Professional Core Course (PCC)

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
3	2	1	0	0	45

COURSE OBJECTIVES	
1.	To provide basic knowledge in transportation so that students can understand and solve transportation-related problems and design for highway mode of transportation, focusing on highway users' characteristics, geometric and pavement design, traffic engineering, and transportation planning.

COURSE CONTENT		
Units	**Description**	**Cont. Hours**
1.	**Introduction:** Scope, history, classification of roads. Comparison with other modes of transportation.	**10**
2.	**Alignment Design:** Route survey and highway location. Geometric design: cross-section elements; sight distances, horizontal and vertical alignment	**10**
3.	**Pavement Design:** Factors affecting pavement design, types of pavements, Methods of flexible pavement design.	**10**
4.	**Rigid Pavement Design:** Stress due to load and temperature in rigid pavements, Introduction to design methods of rigid pavements	**08**
5.	**Highway Materials and Construction:** Properties and tests for road aggregates and bituminous materials, design of bituminous concrete mix, methods of preparing the subgrade, base course, and construction of various types of surface covers.	**07**

COURSE OUTCOMES	
CO 1.	Give necessary information, prepare a horizontal and vertical alignment, including super elevation, which complies with AASHTO standards.
CO 2.	Understand the relationship between the environment and transportation infrastructure and its importance in project development of transportation projects.
CO 3.	Utilize CAD software to prepare a plan, profile, and x-sections depicting a typical roadway design.
CO 4.	Prepare well-written design narratives documenting the various parameters and standards used in the design process so another individual could review the work and understand what decisions and assumptions were used and why.
CO 5.	Understand the mathematics behind the development of tables and charts for determining highway design criteria.

TEXT BOOKS/REFERENCES		
S. No	**Book/Text Title**	**Author**
1.	Highway Engineering.	Khanna, S.K. and Justo.
2.	Highway Engineering	Bhanot, K.L.
3.	Principles of Transportation and Highway Engineering.	Rao, G.V.
4.	Pavement Design and Management Guide by Transportation Association of Canada.	Ottawa, Ontario, Edn. Dr. Ralph Haas,

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	6th
COURSE TITLE	**Engineering Hydrology**
COURSE CODE	CIV-353-C
COURSE CATEGORY	Professional Core Course (PCC)

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
3	2	1	0	0	45

COURSE OBJECTIVES	
1.	To impart the knowledge for understanding elementary aspects of hydrology.
2.	To know diverse methods of collecting the hydrological information, which is essential, to understand surface and ground water hydrology.
3.	To know the basic principles and movement of ground water and properties of ground water flow.
4.	To impart the knowledge of Fluvial Hydraulics for use in the planning, design, and management of water resources projects.
5.	To impart knowledge of reservoir design studies for practical use.

COURSE CONTENT		
Units	**Description**	**Cont. Hours**
1.	**Hydrology:** Scope and applications of Hydrological cycle; precipitation its mechanism, forms, weather systems, Indian scenario, measurement by rain Gauges, gauge network adequacy, missing data determination, and consistency. Hyetographs and methods of determining mean rainfall. Hydrological Abstractions: Evaporation, factors affecting, measurement, empirical equations, analytical methods, reservoir evaporation; Evapotranspiration, its measurement, ET Equations, potential evapotranspiration. Transportation, Interception, Depression storage, Infiltration.	**10**
2.	**Stream flow:** Stream flow measurement: Direct and indirect methods, stage-discharge relationship. Factors affecting Runoff. Rainfall-Runoff relationships. Unit Hydrograph, Peak Flow, velocity Discharge measurements. Hydrographs: Definition, components, base flow separation, effective rainfall, unit hydrograph, its derivation, applications, and limitations.	**10**
3.	**Flood Estimation And Groundwater:** Occurrence and distribution of floods; various methods of flood estimation; viz Rational method, empirical methods, U.H. method, Design flood definition. Flood routing: Reservoir and channel routing. Occurrence and distribution of ground Water, types of aquifers,	**10**

	aquifer properties, Darcy's law, and steady one-dimensional aquifer flow, Well Hydraulics: Steady flow to wells in confined and unconfined aquifers.	
4.	**Reservoir Design Studies:** Types of reservoirs, storage capacity, Mass-curve technique, fixation of capacity, safe yield, And reservoir sedimentation: trap efficiency, capacity inflow ratio, life of reservoirs.	**08**
5.	**Fluvial Hydraulics:** Principles of sediment transport, critical tractive force, Shield's plot, Bed and suspended load. Bed movement, White's Theory, Rigid and loose Boundaries.	**07**

COURSE OUTCOMES	
CO 1.	To perform multiple analysis on precipitation data.
CO 2.	To estimate various components of hydrological cycle such as stream flow, runoff, evapotranspiration and infiltration.
CO 3.	To measure components of hydrological water balance in field.
CO 4.	To perform hydrograph analysis and estimate magnitude of flood.
CO 5.	To determine reservoir capacity and sedimentation.

TEXT BOOKS/REFERENCES		
S. No	**Book/Text Title**	**Author**
1.	Engineering Hydrology	Subramanaya, K.
2.	Hydrology for Engineers	Linsely, K., Kohler, A. and Paulhus L.H.
3.	Irrigation Water power and water Resources Engineering	Arora, K.R.
4.	Hydrology Principles Analysis and Design	Ragunath, H.M.
5.	Mechanics of sediment transportation and alluvial stream problems	Garde, R.J. and RangaRaju K.G.

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	6th
COURSE TITLE	**Structural Analysis-III**
COURSE CODE	CIV-354-C
COURSE CATEGORY	Professional Core Course (PCC)

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
3	2	1	0	0	45

COURSE OBJECTIVES	
1.	To introduce the concept and applications of Influence Line Diagrams (ILDs) for both determinate and indeterminate structures.
2.	To equip students with the ability to analyze various types of arches, including three-hinged, two-hinged, and fixed arches under different loading conditions.
3.	To understand the structural behavior of cables and suspension bridges, including temperature effects and the role of stiffening girders.
4.	To explain the principles of plastic analysis and its application in determining the collapse load of structures.
5.	To develop problem-solving skills and an analytical approach towards structural behavior under moving loads and ultimate load conditions.

COURSE CONTENT		
Units	**Description**	**Cont. Hours**
1.	**INFLUENCE LINE DIAGRAMS FOR DETERMINATE STRUCTURES:** Influence line for reactions in statically determinate beams, Principles of influence lines, and application to determinate structures (Beams, Trusses, Arches). Criteria for absolute 'maximum moment and shear under a series of moving loads. Muller Breslau's Principle.	10
2.	**INFLUENCE LINE DIAGRAMS FOR INDETERMINATE STRUCTURES:** Influence line for shear force, bending moment, and support reaction components ofindeterminate beams and arches.	10
3.	**ARCHES:** 'Types of Arches, Analysis of Three Hinged Arches, Two Hinged and Fixed Arches-Parabolic Arches and circular arches, Rib Shortening and temperature Effects.	8
4.	**CABLES AND SUSPENSION BRIDGE:** Statics of suspension cable, Cables supported at different levels, Temperature effect, Analysis of suspension bridge with and without stiffening girders	7

5.	**PLASTIC METHOD:** 'Concept, Assumptions, Shape Factor for different cross-section, Collapse Load, Load Factor, Plastic modulus of a section, Plastic moment of resistance, Theorems of plastic analysis, "Methods of analysis. Computation of Collapse load for a fixed beam and continuous beam	10

COURSE OUTCOMES	
CO 1.	**Develop and interpret Influence Line Diagrams** for determinate and indeterminate structures.
CO 2.	**Analyze and evaluate arch structures** considering rib shortening and thermal effects.
CO 3.	**Apply the principles of structural mechanics to suspension systems**, including cables and suspension bridges with or without stiffening systems.
CO 4.	**Apply plastic analysis methods to fixed and continuous beams** and compute collapse loads effectively.
CO 5.	**Critically assess structural stability and load carrying capacity**, helping in designing safer and more economical structures.

TEXT BOOKS/REFERENCES		
S. No	**Book/Text Title**	**Author**
1.	Structural Analysis	R.C. Hibbeler
2.	Structural Analysis	C.S. Reddy
3.	Advanced Structural Analysis	Devdas Menon
4.	Plastic Analysis of Structures	M.L. Gambhir

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	6th
COURSE TITLE	**Traditional Wisdom for Earthquake Resistant & Disaster Resilient Designing**
COURSE CODE	CIV-355-C
COURSE CATEGORY	Indian Knowledge System (Core)

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
1	1	0	0	0	15

COURSE OBJECTIVES	
1.	To familiarize students with traditional construction wisdom for seismic safety.
2.	To introduce indigenous materials and techniques that enhance disaster resilience.

COURSE CONTENT		
Units	**Description**	**Cont. Hours**
1.	**Traditional Seismic Wisdom and Practices** • Introduction to vernacular architecture in seismic zones • Case studies from Himalayan and Japanese traditional buildings • Importance of timber-laced masonry, symmetrical layouts, light roofing • Traditional practices of bracing, tying, and energy dissipation • Role of community knowledge and inter-generational transmission	7.5
2.	**Materials and Methods in Disaster Resilience** • Overview of local materials (mud, timber, bamboo, lime) • Construction techniques: dhajji dewari, kath kuni, cob, adobe • Advantages of traditional materials: flexibility, thermal performance, cost-effectiveness • Integration of modern tools with traditional methods for hybrid solutions • Government schemes and codes that promote traditional practices	7.5

COURSE OUTCOMES	
CO 1.	Understand the importance of traditional seismic design elements and practices.
CO 2.	Apply local construction techniques to enhance building resilience against earthquakes.

TEXT BOOKS/REFERENCES		
S. No	**Book/Text Title**	**Author**
1.	Earthquake Resistant Traditional Construction	Arya, A.S.
2.	Vernacular Architecture in the Himalayas	V. S. Vyas
3.	Guidelines for Earthquake Resistant Non-Engineered Construction	UNESCO
4.	Building Materials & Construction	G.C. Sahu
5.	Traditional Buildings: A Global Survey of Structural Forms and Design	B. Feilden

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	6th
COURSE TITLE	**Geotechnical Engineering Lab-II**
COURSE CODE	CIV-366-C
COURSE CATEGORY	Professional Core Course (PCC)

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
1	0	0	2	0	30

COURSE OBJECTIVES	
1.	To understand different characteristics of the soil.

COURSE CONTENT		
Units	**Experiments**	**Cont. Hours**
1.	Consolidation Test	**4**
2.	Direct Shear Test	**4**
3.	Unconfined Compression Test	**3**
4.	Unconsolidated Undrained Triaxial Test	**4**
5.	Vane Shear Test	**4**
6.	Consolidated Undrained Triaxial Test	**4**
7.	Standard Penetration Test	**4**
8.	Plate Load Test	**3**

COURSE OUTCOMES	
CO 1.	Determine consolidation characteristics of a given soil sample.
CO 2.	Obtain shear strength parameters of different types and consistencies of soils and under different drainage conditions.
CO 3.	Perform a Standard Penetration test of soil to obtain SPT (N) – value.
CO 4.	Determine allowable soil pressure of soil foundation system by vertical plate load test.

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	6th
COURSE TITLE	**Transportation Engineering Lab-I**
COURSE CODE	CIV-367-C
COURSE CATEGORY	Professional Core Course (PCC)

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
1	0	0	2	0	30

COURSE OBJECTIVES	
1.	Learn the Fundamentals of Bitumen and & its engineering behaviour.
2.	Learn the Fundamentals of Aggregate & its engineering behaviour.

COURSE CONTENT		
Units	**Description**	**Cont. Hours**
1.	**TESTS ON AGGREGATE**: Aggregate grading , Specific Gravity, Crushing Abrasion, Impact, Soundness, Flakiness, Shape, Fineness Modulus.	**15**
2.	**TESTS ON BITUMEN:** Viscosity, Penetration, Softening point, Flash & Fire Point, Ductility.	**15**

COURSE OUTCOMES	
CO 1.	Identify engineering properties of aggregate.
CO 2.	Identify the grade & properties of bitumen.

TEXT BOOKS/REFERENCES		
S. No	**Book/Text Title**	**Author**
1.	"Highway Engineering". Nem Chand Brothers, Roorkee	Khanna, S.K. and Justo,
2.	Highway Materials and Pavement Testing., Nem Chand Brothers, Roorkee.	Khanna, Justo & Veeraragavan
3.	Material Testing Laboratory Manual Standard Publishers, Nai Sarak, Delhi	Kukreja, Kishore &Chawla,

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	7th
COURSE TITLE	**Design of Concrete Structures-II**
COURSE CODE	CIV-401-C
COURSE CATEGORY	Professional Core Course (PCC)

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
3	2	1	0	0	45

COURSE OBJECTIVES	
1.	Apply advanced Limit State Design principles for the analysis and design of foundations, retaining walls, and liquid retaining structures in accordance with relevant Indian Standard codes (IS 456, IS 3370, IS 875).
2.	Develop proficiency in structural design of substructures, including isolated, combined, strip, and mat footings, ensuring safety against bending, shear, punching, and stability failures.
3.	Design and evaluate retaining walls and water tanks considering earth pressures, load effects, serviceability requirements, and crack control provisions as per codal guidelines

COURSE CONTENT		
Units	**Description**	**Cont. Hours**
1.	This unit covers the philosophy of Limit State Design including ultimate and serviceability limit states, partial safety factors for loads and materials, standard load combinations involving dead load and live load as per IS 875, and durability provisions including cover requirements as specified in IS 456:2000. The unit also introduces the relevant Indian Standard codes applicable to foundation, retaining wall, and water tank design.	**06**
2.	This unit focuses on the design of shallow foundations including isolated and combined footings. Topics include bearing capacity considerations, allowable soil pressure, determination of footing size, calculation of factored soil pressure, bending moment at the face of the column, one-way shear and two-way (punching) shear checks, and reinforcement design and detailing in accordance with IS 456:2000 and IS 6403. The design of rectangular combined footings under eccentric loading conditions is also included.	**10**
3.	This unit deals with the design of strip footings subjected to wall loads including pressure distribution assumptions, bending and shear checks, and reinforcement detailing. The unit introduces rigid mat foundation analysis with simplified assumptions and basic design approach. Design of pedestals and their stress checks under axial loads are also covered in accordance with IS 456:2000 and IS 1904 provisions	**08**

4.	This unit covers the analysis and design of cantilever retaining walls. Rankine's theory of earth pressure is introduced to determine active and passive earth pressures. Stability checks including overturning, sliding, and bearing pressure are carried out. Structural design of the retaining wall stem, heel slab, and toe slab is performed as per IS 456:2000. The effect of surcharge loads as per IS 875 is also considered in design. Students shall model a cantilever retaining wall in ETABS using shell elements and apply triangular earth pressure based on Rankine's theory. The bending moment diagram at the base of the stem shall be obtained and compared with the manually calculated cantilever bending moment. Observations on variation between classical theory and finite element results shall be documented.	**10**
5.	This unit introduces liquid retaining structures and emphasizes serviceability requirements and crack control provisions as per IS 3370 (Part 1–4). The analysis and design of rectangular water tanks including bending and direct tension effects are covered. Hoop tension in circular water tanks and the design of ring beams and base slabs are discussed. Relevant reinforcement detailing provisions as per IS 3370 and IS 456:2000 are included.	**09**

COURSE OUTCOMES	
CO 1.	Apply Limit State Design principles and relevant Indian Standard codes to the analysis and design of foundations, retaining walls, and liquid retaining structures.
CO 2.	Design isolated, combined, strip, and mat footings considering bearing capacity, bending, shear, punching shear, and serviceability requirements.
CO 3.	Analyze and design cantilever retaining walls by evaluating earth pressures and performing stability checks against overturning, sliding, and bearing failure.
CO 4.	Design rectangular and circular water tanks in accordance with IS 3370 provisions, ensuring crack control and serviceability performance.
CO 5.	Develop complete structural design solutions with appropriate reinforcement detailing and codal compliance for practical civil engineering applications.

TEXT BOOKS/REFERENCES		
S. No	**Book/Text Title**	**Author**
1.	Advanced Reinforced Concrete Design	Krishna Raju, N. CBS Publishers and Distributors Pvt Ltd.
2.	Comprehensive RCC Design	Punmia, B. C., Jain, A. K., and Jain, A. K. Laxmi Publications.
3.	Reinforced Concrete Design	Pillai, S. U., Menon, D. Tata McGraw Hill.
4.	Reinforced Concrete Structures	Park, R., and Paulay, T, John Wiley and Sons
5.	Plant-cast: Precast and Prestressed Concrete	Sheppard, D. A., and Phillips, W. R. Mc, Graw Hill.
6.	IS 456:2000 – Plain and Reinforced Concrete – Code of Practice. BIS	BIS
7.	IS 3370 (Part 1–4) – Code of Practice for Concrete Structures for the Storage of Liquids. BIS	BIS
8.	IS 6403 – Code of Practice for Determination of Bearing Capacity of Shallow Foundations. BIS	BIS
9.	IS 1904 – Code of Practice for Design and Construction of Foundations in Soils. BIS	BIS

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	7th
COURSE TITLE	**Irrigation & Hydraulic Structures**
COURSE CODE	CIV-402-C
COURSE CATEGORY	Professional Core Course (PCC)

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
3	2	1	0	0	45

COURSE OBJECTIVES	
1.	To develop the understanding of necessity of Irrigation and requirements
2.	To introduce the basic concepts relevant to Irrigation and its techniques.
3.	To understand the principles of Design of Irrigation & Hydraulic Structures.
4.	To study the causes and the preventive measures for water logging and flooding.
5.	To study the importance of cross drainage works and types

COURSE CONTENT		
Units	**Description**	**Cont. Hours**
1.	**General Introduction:** The necessity of Irrigation in India, Advantages and Disadvantages of Irrigation, Techniques of water distribution in farms, Soil moisture & Crop water requirements; Duty, Delta, Base period, Crop period, Consumptive use, Irrigation requirements	**09**
2.	**Canal Irrigation:** Types of canals, parts of a canal irrigation system with diagram, channel alignment, assessment of water requirements, distribution system of canal irrigation, estimation of channel losses, design of channels by regime & semi-theoretical approaches, Canal lining	**09**
3.	**Cross Drainage Works:** The necessity of Cross Drainage works, their types, selection, Design of various types of Cross Types of Drainage works- Aqueduct, Syphon Aqueduct, Super passage, Syphon super passage (canal syphon), Level Crossing, Detailed design of Aqueduct.	**09**
4.	**Diversion Head works:** Parts of diversion head works, types of weirs and barrages, introduction to design of weirs on permeable foundations, control of silt entry into a canal, silt excluders, Silt ejectors and their drawing. A basic introduction to Bligh's theory. A detailed study of Khosla's theory.	**09**
5.	**Water Logging & Flood Control:** Causes & Preventive measures of waterlogging, Drainage of irrigated lands, saline & alkaline lands, Flood problems, types of floods, Flood control measures	**09**

COURSE OUTCOMES	
CO 1.	To optimize the effective usage of water resources for irrigation purposes.
CO 2.	To comprehend the basic design principles for the development of an efficient irrigation system.
CO 3.	To design channels and other irrigation structures required for irrigation, drainage, flood control, and other water-management projects.
CO 4.	To identify a suitable method of irrigation and drainage of the waterlogged area.

TEXT BOOKS/REFERENCES		
S. No	**Book/Text Title**	**Author**
1.	Irrigation Water power & Water Resources Engineering	Arora, K.R.
2.	Irrigation Engineering	G. Singh
3.	Theory and Design of Irrigation Structures	Varshney & Gupta
4.	Irrigation Engineering	I. E. Houk
5.	Irrigation	J. D. Zimmerman
E-REFERENCES		
6.	https://nptel.ac.in/courses/126105010	
7.	https://nptel.ac.in/courses/105104103	
8.	https://archive.nptel.ac.in/courses/105/105/105105203/	

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	7th
COURSE TITLE	**Transportation Engineering-II**
COURSE CODE	CIV-403-C
COURSE CATEGORY	Professional Core Course (PCC)

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
3	2	1	0	0	45

COURSE OBJECTIVES	
1.	The objectives of this course are to learn the transportation fundamentals.
2.	To expose the students to Railway planning, design, construction and maintenance, and planning and design principles of Airports and Harbors.

COURSE CONTENT		
Units	**Description**	**Cont. Hours**
1.	Components of traffic system- vehicle characteristics; human characteristics, road characteristics & traffic-control devices.	**9**
2.	Traffic flow theory-flow parameters; fundamental relation of traffic flow, road capacity, and level of service concept.	**10**
3.	Intersections- signalized intersections, channelization and roundabouts	**8**
4.	Railway Development of Indian railways. Permanent way and its component, formation width, ballast, sleepers, rails. Creep and tilt in rails.	**8**
5.	Railway Tracks: Track resistance and tractive effort, gauge problem, super-elevation near branching of curves, gradients. Track fittings and fastenings, points and crossings, station Platforms, yards, and sidings.	**10**

COURSE OUTCOMES	
CO 1.	Students who complete this course will be able to use transportation fundamentals in field.
CO 2.	The students will have the ability to Plan and Design various civil Engineering aspects of Railways, Airports, and Harbors.

TEXT BOOKS/REFERENCES		
S. No	**Book/Text Title**	**Author**
1.	Railway Engineering	Rangawala, S.C.
2.	Railway Engineering	Arora, S.P. and Saxena.
3.	Airport Planning and Design	Khanna, Arora and Jain.
4.	Airport Planning and Design	Horren Jeff.

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	7th
COURSE TITLE	**Waste Water Engineering**
COURSE CODE	CIV-404-C
COURSE CATEGORY	Professional Core Course (PCC)

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
3	2	1	0	0	45

COURSE OBJECTIVES	
1.	To acquire knowledge on physical and chemical properties of water
2.	To get knowledge on the working principles of various physical, chemical, and biological treatment systems for water and wastewater, including sludge.
3.	To understand the principles of Design of physical, chemical and biological treatment systems.
4.	To get knowledge about the various modes of conveyance of wastewater from the source of its generation to the treatment plant.
5.	To study the causes and preventive measures of various types of environmental pollution.

COURSE CONTENT		
Units	**Description**	**Cont. Hours**
1.	**Environmental Pollution:** Importance of clean environment, Sources of pollution to land, water & air, General effects of pollution, pollution by sewage, calculation of storm water & sewage, Time of concentration and Intensity of storm.	**08**
2.	**Sewage Disposal:** Methods of sewage disposal, effects of disposal on land, in water bodies, self-purification of streams, BOD calculations, Types & design of sewers.	**12**
3.	**Sewage Treatment:** Unit operations in sewage treatment, Screening, sedimentation, grit removal etc. septic and Imhoff tanks, soakage's for isolated systems, Filtration, activated sludge process, Oxidation ponds, Methods of aeration.	**10**
4.	**Air Pollution And Its Preventive Measures:** Air Pollution & its effects on human health, factors responsible for air pollution, measurement of air pollution, air quality standards, and Engineering interventions to check air pollution, case studies relating to the topic.	**08**
5.	**Solid Waste Management:** Solid waste problems, constituents of solid waste; Collection, transport and disposal of Solid waste .land filling, composting, incineration.	**07**

COURSE OUTCOMES	
CO 1.	An ability to estimate sewage generation and design sewer system.
CO 2.	The required understanding on the characteristics and composition of sewage, self-purification of streams.
CO 3.	An ability to perform basic design of the unit operations and processes that are used in sewage treatment.
CO 4.	Understand the standard methods for disposal of sewage.
CO 5.	Gain knowledge on sludge treatment and disposal.

TEXT BOOKS/REFERENCES		
S. No	**Book/Text Title**	**Author**
1.	Sewage Treatment & Disposal & Waste Water Engineering.	Modi, P.N.
2.	Water supply & sanitary Engineering	Punmia, B.C.
3.	Environmental engineering & management	Suresh K. Dhameja
4.	Wastewater Engineering: Treatment and Reuse	Metcalf and Eddy
5.	Environmental Engineering Sewage Waste Disposal and Air Pollution	S.K.Garg
E-REFERENCES		
6.	https://archive.nptel.ac.in/courses/105/106/105106119	
7.	https://archive.nptel.ac.in/courses/105/104/105104102	
8.	https://www.edx.org/learn/environmental-science/tsinghua-university-water-andwastewater-treatment-engineering-biochemical-technology-shui-chu-li-gong-chengsheng-wu-hua-xue-fang-fa	

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	7th
COURSE TITLE	**Seminar**
COURSE CODE	CIV-416-C
COURSE CATEGORY	Professional Core Course (PCC)

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
1	0	0	1	1	30

COURSE OBJECTIVES	
1.	To encourage and motivate the students to read and collect recent and relevant information from their area of interest confined to the relevant discipline from technical publications including peer reviewed journals, conferences, books, project reports, etc., prepare a report based on a central theme and present it before a peer audience.

MODUS OPERANDI		
Units	**STEPS**	**Cont. Hours**
1.	A seminar shall be organized at the 7th semester of the Civil Engineering curriculum leading to the Degree of B.Tech. in Civil Engineering. The students shall conduct thorough research on a topic of their choice, either library research or laboratory research. The students shall be guided in their research work by the staff members of the department. The students shall then make a hard-copy of their seminar report & submit it in the Seminar coordinator's office following which they will be asked to present their research work before their fellow students.	30
2.	The students shall make a PowerPoint presentation of 15-20 minutes duration on the research work in front of their fellow students under the supervision of the faculty member/s assigned. A discussion on the same topic will follow the seminar presentation.	

COURSE OUTCOMES	
CO 1.	Identify and familiarize with some of the good publications and journals in their field of study.
CO 2.	Acquaint oneself with the preparation of independent reports, name them based on a central theme, and write abstracts, main body, conclusions, and references to identify their intended meaning and style.
CO 3.	Understand effective use of presentation tools, generate confidence in presenting a report before an audience and improve their skills in the same.
CO 4.	Develop skills like time management, leadership quality, and bond with an audience.

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	7th
COURSE TITLE	**Transportation Lab-II**
COURSE CODE	CIV-417-C
COURSE CATEGORY	Professional Core Course (PCC)

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
1	0	0	2	0	30

COURSE OBJECTIVES	
1.	To provide basic knowledge in transportation so that students can understand and solve transportation-related problems and design for highway mode of transportation with a focus on highway users' characteristics, geometric and pavement design, traffic engineering, and transportation planning

COURSE CONTENT		
Units	**Experiments/Practicals**	**Cont. Hours**
1.	Conduct traffic volume, speed, and O-D studies for analyzing road user behavior.	6
2.	Perform road inventory surveys and pavement condition assessments including PCI evaluation.	6
3.	Understand parking demand and perform a parking study with practical design recommendations.	6
4.	Study road safety aspects including accident spot identification and analysis of black spots.	6
5.	Design, optimize, and evaluate traffic signal systems based on traffic surveys and delay analysis.	6

COURSE OUTCOMES	
CO 1.	Analyze and interpret traffic flow characteristics for designing roadways and intersections.
CO 2.	Assess pavement condition and recommend maintenance strategies based on field data and Pavement Condition Index (PCI).
CO 3.	Evaluate parking requirements, design effective parking facilities, and propose suitable solutions for urban and highway environments.
CO 4.	Identify critical accident zones and recommend safety improvements for better traffic management and accident reduction.
CO 5.	Design traffic signals using traffic flow data, optimize signal timing, and improve level of service (LOS) at intersections.

TEXT BOOKS/REFERENCES		
S. No	**Book/Text Title**	**Author**
1.	"Highway Engineering". Nem Chand Brothers, Roorkee	Khanna, S.K. and Justo,
2.	Highway Materials and Pavement Testing., Nem Chand Brothers, Roorkee.	Khanna, Justo & Veeraragavan
3.	Material Testing Laboratory Manual Standard Publishers, Nai Sarak, Delhi	Kukreja, Kishore &Chawla,

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	7th
COURSE TITLE	**Pre Project**
COURSE CODE	CIV-418-C
COURSE CATEGORY	Professional Core Course (PCC)

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
2	0	0	4	0	60

COURSE OBJECTIVES	
1.	To identify a research/industry related problem for the undergraduate project work with the respective faculty's guidance, and prepare a design and work plan.

MODUS OPERANDI

Each group comprising of around 5 students shall identify a project related to the curriculum of study. At the end of the semester, a preliminary synopsis report on the project shall be submitted to the Department for assessment. The students will be required to appear for viva voce, which shall be conducted in the department, in the faculty members' presence under the supervision of the HOD.

EVALUATION MECHANISM

S. No.	**Criteria**	**Max. Marks**
1.	Attendance and Regularity	10
2.	Theoretical Knowledge and Individual Involvement	40
3.	Quality and Contents of Project Synopsis	30
4.	Presentation (in Presence of External Expert)	20
Total Marks		100

COURSE OUTCOMES	
CO 1.	Conduct a literature survey in a relevant area of one's course of study and finally identify and concentrate on a particular problem in the field of civil engineering
CO 2.	Formulate a project proposal through extensive literature and/or discussion with learned resource persons in the industry and around.
CO 3.	Generate a proper execution plan of the project work to be carried out in phase second in the 8th semester through deliberations and improve presentation skills.

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	7th
COURSE TITLE	**Industrial Training (Internship)**
COURSE CODE	CIV-419-C
COURSE CATEGORY	Professional Core Course (PCC)

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
1	0	0	0	7.5	30

COURSE OBJECTIVES	
1.	Recognise the importance of material manufacturing in Civil Engineering
2.	Recognise the methods of Construction
3.	Gain knowledge of Quality checks at Construction sites

COURSE CONTENT		
S. No	**Components of Training**	**Duration**
1.	Visiting various material manufacturing plants/sites and Project Sites and collecting information about the Project, its cost, duration, methods of manufacturing, analysis, design, and construction of the site. Also, to gain knowledge on Quality evaluation at different plants or sites.	**4-Weeks**
2.	Collecting all data, writing a Short technical report, and demonstrating for evaluation before a committee comprising of three Faculty members of the Department. Student Also Require to Submit their Workplan and a detailed report (duly signed by the site in-charge/supervisor) highlighting the important Learning Outcomes.	

COURSE OUTCOMES	
To accomplish skills/abilities for the following:	
CO 1.	Enhance Practical Knowledge of the Manufacturing and Construction Sites.
CO 2.	Building Professional Know-how.
CO 3.	Refreshing the Theoretical Subject Knowledge.

TEXT BOOKS/REFERENCES	
S. No	**Book/Text Title**
1.	Engineering Training Manuals by US Army
2.	Dennis Lemaitre, Training Engineers for Innovation. 2018
3.	M. MacDonald Steels, Effective Training for Civil Engineers. 1994

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	8th
COURSE TITLE	**Earthquake Resistant Design**
COURSE CODE	CIV-450-C
COURSE CATEGORY	Professional Core Course (PCC)

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
3	2	1	0	0	45

COURSE OBJECTIVES	
1.	To introduce the fundamentals of structural dynamics and their role in earthquake engineering.
2.	To analyze earthquake loads and structural response using various analysis methods.
3.	To develop an understanding of earthquake-resistant design principles for RCC and masonry structures.
4.	To emphasize the importance of ductility in seismic design as per IS 13920.
5.	To familiarize students with seismic codal provisions for masonry structures as per IS 4326.

COURSE CONTENT		
Units	**Description**	**Cont. Hours**
1.	**Structural Dynamics and Earthquake Excitations** Fundamentals of structural dynamics: Free and forced vibration of single-degree-of freedom (SDOF) systems, equation of motion, damping, resonance, and natural frequency. Seismic excitation and response: Characteristics of earthquakes, earthquake ground motion parameters, response spectrum concept and its significance in seismic design.	**7**
2.	**Earthquake Load Analysis Methods** Concept of seismic design philosophy: Strength, stiffness, and ductility. Earthquake load analysis methods based on structural dynamics: Linear Static Analysis: Seismic coefficient method (Equivalent Static Method). Linear Dynamic Analysis: Response spectrum method. Non-Linear Static Analysis: Pushover analysis and performance-based design. Non-Linear Dynamic Analysis: Time-history analysis. Introduction to IS 1893 (Part 1):2016 provisions for seismic load analysis.	**8**

3.	Earthquake-Resistant Design of RCC Structures Seismic design of RCC elements as per IS 1893: Beams: Flexural and shear design under earthquake loads. Slabs: Role in lateral load transfer. Columns: Interaction of axial and lateral loads. Shear Walls: Placement and design considerations. Foundation Systems: Soil-structure interaction and seismic foundations.	**10**
4.	**Ductility Considerations in Earthquake-Resistant Design** Concept of ductility and its importance in seismic design. Seismic design and detailing guidelines as per IS 13920:2016: Ductile detailing of RCC beams, columns, and joints. Reinforcement requirements for seismic energy dissipation. Capacity design approach for earthquake-resistant structures. Structural irregularities and their effect on earthquake performance.	**10**
5.	**Seismic Codal Provisions for Masonry Structures** Seismic behavior of masonry structures: Strength, ductility, and failure mechanisms. Codal provisions for brick masonry buildings as per IS 4326. Seismic strengthening and retrofitting techniques: Reinforcement methods for improving seismic resistance. Case studies on seismic failure and retrofitting of masonry buildings.	**10**

COURSE OUTCOMES	
CO 1.	**Evaluate Structural Response to Earthquakes** – Analyze free and forced vibrations of SDOF systems, seismic ground motion parameters, and response spectra for earthquake-resistant design.
CO 2.	**Apply Seismic Load Analysis and Design Principles** – Implement linear and non-linear seismic analysis methods as per IS 1893 (Part 1):2016 for RCC structures, ensuring strength, stiffness, and ductility.
CO 3.	**Design and Retrofit Earthquake-Resistant Structures** – Incorporate ductile detailing as per IS 13920:2016 and seismic strengthening techniques for masonry structures following IS 4326.
CO 4.	**Evaluate Structural Response to Earthquakes** – Analyze free and forced vibrations of SDOF systems, seismic ground motion parameters, and response spectra for earthquake-resistant design.

TEXT BOOKS/REFERENCES		
S. No	**Book/Text Title**	**Author**
1.	Dynamics of Structures	Anil K. Chopra
2.	Seismic Design of Structures.	Pankaj Aggarwal & Shrikhande
3.	Seismic Design of RCC Masonry Structures	Pauley, T. & Priestley
4.	Relevant IS Codes	IS 1893 (P1):2016, IS 13920:2016, IS 4326:1993

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	8th
COURSE TITLE	**Project**
COURSE CODE	CIV-466-C
COURSE CATEGORY	Professional Core Course (PCC)

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
12	0	0	24	0	360

COURSE OBJECTIVES	
1.	Understand Team Work and attain Professional attitude
2.	Recognize and analyze Problem/s
3.	Attain result/s and demonstrate those results before expert/s
4.	Gain knowledge in report writing

COURSE CONTENT		
Units	**Description**	**Cont. Hours**
1.	**The Project Work is composed of Two Parts:** 1. Collecting Literature. Doing Experimental Work, fieldwork, analyzing and designing, taking case studies, or building demonstrative models. 2. Collecting all data, writing a technical report and demonstrating for evaluation before a committee. **The composition of the committee is:** a. Three faculty members of the Department, including the Supervisor concerned. b. An External Expert as approved by Competent Authority. **The Committee mandate of evaluation will be:** I. 40% to Supervisor. II. 60% to Committee out of which external expert will evaluate 50%.	360

COURSE OUTCOMES	
CO 1.	Enhance the technical capacities.
CO 2.	Building Professional Know-how.
CO 3.	Refreshing the Subject Knowledge.

TEXT BOOKS/REFERENCES	
S. No	**Book/Text Title**
1.	Diana L.Friad, Project Work. Oxford University Press. 2002
2.	Anders Siing Anderson, Simon B. Heilesen, The Roskilde Model: Problem-Oriented Learning and Project Work. Springer International Publishing. 2014

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	8th
COURSE TITLE	**Dynamic and Earthquake Engineering Laboratory**
COURSE CODE	CIV-467-C
COURSE CATEGORY	Professional Core Course (PCC)

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
1	0	0	2	0	30

COURSE OBJECTIVES	
1.	To develop practical understanding of structural dynamics and earthquake engineering concepts through laboratory experimentation and numerical simulation.
2.	To familiarize students with vibration characteristics of structures including natural frequency, damping ratio, resonance, and mode shapes.
3.	To introduce modern structural instrumentation techniques using sensors, data loggers, and data acquisition systems.
4.	To provide exposure to earthquake ground motion processing, dynamic analysis, performance-based seismic assessment, and structural health monitoring concepts.

COURSE CONTENTS

Units	**Description**	**Cont. Hours**
1	Introduction to structural dynamics laboratory and vibration testing equipment. Familiarization with laboratory instruments and safety procedures. Free vibration tests on Single Degree of Freedom (SDOF) systems. Determination of natural frequency, natural period, and damping ratio using logarithmic decrement method. Comparison of theoretical and experimental results.	06
2	Forced vibration experiments on SDOF systems. Study of resonance phenomenon, frequency-response behaviour, dynamic magnification factor, transmissibility, and vibration isolation. Investigation of the influence of damping on structural response under harmonic excitation.	06
3	Experimental investigation of Multi-Degree-of-Freedom (MDOF) structural systems. Determination of mode shapes, natural frequencies, modal participation, and dynamic characteristics of structural models. Comparison between analytical and experimental modal properties.	06
4	Structural instrumentation and monitoring. Introduction to accelerometers, strain gauges, displacement transducers (LVDTs), load cells, data loggers, wireless sensors, and data acquisition systems. Sensor calibration, signal conditioning, dynamic response measurement, recording and interpretation of structural response data. Introduction to Structural Health Monitoring (SHM) concepts and applications.	06

5	Earthquake engineering applications. Processing and interpretation of earthquake ground motion records. Development of elastic response spectra using spreadsheet and software tools. Introduction to nonlinear structural behaviour, pushover testing concepts, capacity curves, performance point determination, and plastic hinge formation. Dynamic modelling of building frames using ETABS/SAP2000. Determination of natural periods, mode shapes, modal participation factors, and response spectrum analysis as per IS 1893:2024.	06

LIST OF SUGGESTED EXPERIMENTS

1. Free vibration test on SDOF system.
2. Determination of damping ratio using logarithmic decrement.
3. Forced vibration and resonance experiment.
4. Determination of dynamic magnification factor.
5. Modal testing of multi-storey structural models.
6. Determination of mode shapes and natural frequencies.
7. Measurement of acceleration using accelerometers.
8. Measurement of displacement using LVDTs.
9. Strain measurement using electrical resistance strain gauges.
10. Calibration and use of load cells.
11. Data acquisition using data loggers and wireless sensor systems.
12. Processing of earthquake accelerograms.
13. Development of elastic response spectra.
14. Response spectrum analysis of building frames using ETABS/SAP2000.
15. Demonstration of pushover testing concepts and identification of plastic hinges.
16. Comparative study of equivalent static, response spectrum, and pushover analysis methods.

COURSE OUTCOMES

CO 1	Determine natural frequency, natural period, damping ratio, and vibration characteristics of structural systems through laboratory experimentation.
CO 2	Evaluate resonance behaviour and dynamic response of structures subjected to harmonic excitation.
CO 3	Determine modal properties including natural frequencies and mode shapes of multidegree-of-freedom structural systems.
CO 4	Apply structural instrumentation techniques using sensors, data loggers, and data acquisition systems for measurement and interpretation of structural response.
CO 5	Process earthquake ground motion records and perform response spectrum and introductory pushover analyses for seismic performance assessment of structures.

TEXT BOOKS / REFERENCES

S. No	Book/Text Title	Author
1	Dynamics of Structures	Anil K. Chopra
2	Structural Dynamics: Theory and Applications	Mario Paz
3	Earthquake Resistant Design of Structures	Pankaj Agarwal and Shrikhande Manish
4	Dynamics of Structures	Clough and Penzien
5	Structural Dynamics and Earthquake Engineering	S. Rajasekaran

6	IS 1893 (Part 1): 2024 – Criteria for Earthquake Resistant Design of Structures	BIS
7	IS 13920:2016 – Ductile Detailing of Reinforced Concrete Structures Subjected to Seismic Forces	BIS
8	Structural Health Monitoring: A Machine Learning Perspective	Charles Farrar et al.
9	IITK-BMTPC Earthquake Tips and Learning Material	IIT Kanpur

DETAILED SYLLABUS

B.TECH. CIVIL ENGINEERING

(PROFESSIONAL ELECTIVE COURSES)

(Batch 2026 & onwards)

LIST OF PROFESSIONAL ELECTIVE COURSES

S. No	Course Title	Course Code	Semester	Area of Focus
TRACK 1: STRUCTURAL ENGINEERING				
1.	Construction Technology	CIV-206-E	3rd	Ability Enhancement
2.	Construction Management	CIV-255-E	4th	Value Added Course
3.	Design Software	CIV-306-E	5th	Skill Enhancement
4.	Advance Structural Analysis	CIV-356-E	6th	Ability Enhancement
5.	Design of Bridge structure	CIV-405-E	7th	Value Added Course
6.	Pre-Stressed Concrete	CIV-451-E	8th	Value Added Course
TRACK 2: GEO-TECHNICAL ENGINEERING				
7.	Introduction to Geotechnical Engineering	CIV-207-E	3rd	Ability Enhancement
8.	Engineering Geology and Seismology	CIV-256-E	4th	Ability Enhancement
9.	Geotechnical Applications in Construction	CIV-307-E	5th	Entrepreneurship
10.	Rock Mechanics & Tunnelling Technology	CIV-357-E	6th	Ability Enhancement
11.	Geo-Environmental Engineering	CIV-406-E	7th	Value Added Course
12.	Ground Improvement Techniques	CIV-452-E	8th	Value Added Course
TRACK 3: ENVIRONMENTAL ENGINEERING				
13.	Introduction to Green Technology	CIV-208-E	3rd	Ability Enhancement
14.	Environmental Pollution and Control	CIV-257-E	4th	Value Added Course
15.	Solid Waste Management	CIV-308-E	5th	Employability
16.	Climate Change: Impacts, Adaptation, and Resilience in Civil Engineering	CIV-358-E	6th	Ability Enhancement
17.	Environment Impact Assessment & Audit	CIV-407-E	7th	Skill Development
18.	Sustainable Environmental Practices and Quality Control	CIV-453-E	8th	Value Added Course

TRACK 4: HYDROLOGY AND WATER RESOURCE ENGINEERING				
19.	Introduction to Water Supply and Sanitation	CIV-209-E	3rd	Value Added Course
20.	Fluid Mechanics Applications in Engineering	CIV-258-E	4th	Value Added Course
21.	Groundwater Engineering	CIV-309-E	5th	Entrepreneurship
22.	Rural and Urban Sanitation	CIV-359-E	6th	Value Added Course
23.	Hydropower Engineering	CIV-408-E	7th	Skill Development
24.	Industrial Waste Water Treatment	CIV-454-E	8th	Entrepreneurship
TRACK 5: TRANSPORTATION ENGINEERING				
25.	Introduction to Pavement Materials	CIV-210-E	3rd	Ability Enhancement
26.	Road Safety and Management	CIV-259-E	4th	Employability
27.	Sustainable Transportation Infrastructure	CIV-310-E	5th	Value Added Course
28.	Transport Innovations and Industrial Progress	CIV-360-E	6th	Skill Enhancement
29.	Transportation Planning And Economics	CIV-409-E	7th	Employability
30.	Design and Maintenance o f Roads	CIV-455-E	8th	Skill Enhancement
TRACK 6: SKILL DEVELOPMENT IN ENGINEERING				
31.	Soft Skill for Civil Engineers	CIV-211-E	3rd	Skill Enhancement
32.	Entrepreneurship & Start-ups in Civil Engineering	CIV-260-E	4th	Entrepreneurship
33.	Integrated Waste Management for a Smart City	CIV-311-E	5th	Skill Enhancement
34.	Programming for Engineers	CIV-361-E	6th	Skill Enhancement
35.	AI & Machine Learning in Civil Engineering	CIV-410-E	7th	Skill Enhancement
36.	Contracts & Legal Aspects in Civil Engineering	CIV-456-E	8th	Ability Enhancement

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	3rd
COURSE TITLE	Construction Technology
COURSE CODE	CIV-206-E
COURSE CATEGORY	Professional Elective Course (PEC)
ELECTIVE TRACK	Structural Engineering

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
3	2	1	0	0	45

COURSE OBJECTIVES	
1.	To ensure serviceability and durability in newly constructed and renovated buildings.
2.	To asses and evaluate the structural behavior under different load conditions.
3.	To provides a broad overview about construction phase of buildings.
4.	To know concept of sustainability.
5.	To give broad understanding of computer modeling.

COURSE CONTENT		
Units	**Description**	**Cont. Hours**
1.	**Construction Regulation and Standards:** Introduction and importance of construction regulation and standards. Construction Codes and its objectives. Introduction of Types of codes in construction. Report making on implementation of code (hand on practice).	12
2.	**Loads on Building:** Loads on buildings. Factors affecting loads. Importance of load calculations in designing of building elements. Failure in buildings due to loads with at least two case studies.	8
3.	**System of building construction:** Below grade construction. Masonry construction. Concrete construction. Steel construction. Wood construction. Visuals of system of construction.	8
4.	**Sustainable Construction:** History of sustainable construction. Fundamentals of sustainable construction .importance of sustainable construction. Assessment of sustainability. Role of sustainable construction in the modern era.	10
5.	**Building information modeling**:	7

	Introduction to building information mod .concept of building simulation .use of Autodesk in scaling building model from plane to design to construct and manage buildings .concept of project life cycle .concept of building history.	

COURSE OUTCOMES	
CO 1.	Owner and designer may choose to exceed the requirements of code.
CO 2.	Led to develop new structural form.
CO 3.	Learn facets in construction methods.
CO 4.	To construct Environmental friendly structures.
CO 5.	Learner should analyze structure using advanced software.

TEXT BOOKS/REFERENCES		
S. No	**Book/Text Title**	**Author**
1.	Building Materials	Parbin Singh.
2.	Building Materials and Construction	Gurcharan Singh
3.	Building Materials and Construction	Ragawala.
4.	Building Construction	Sushil Kumar

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	4th
COURSE TITLE	Construction Management
COURSE CODE	CIV-255-E
COURSE CATEGORY	Professional Elective Course (PEC)
ELECTIVE TRACK	Structural Engineering

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
3	2	1	0	0	45

COURSE OBJECTIVES	
1.	Prioritization of construction resources.
2.	To know time cost analysis in construction projects.
3.	To asses and evaluate the effects of construction industry.
4.	To assess and evaluate the problems in field related to management.
5.	To enable students to understand and manage various risks associated with construction projects.

COURSE CONTENT		
Units	**Description**	**Cont. Hours**
1.	**Introduction:** History of management thoughts. Definition, importance, objectives and functions of construction management. History of construction management. Contributions made by (i) Taylor (ii) Gantt (iii) Henry Fayol (iv) Elton Mayo (v) chesterun barnard (vi) Mc.Gregor (vii) Herzberg (viii) Linkert (viiii) Maslow (x) Gilbreth (xi) Weber.	12
2.	**Network Techniques:** Introduction to network. Network terminology. Classification of networks, and objectives of network Technique. Development of network. PERT and CPM networks (with examples).	8
3.	**Cost Time Analysis in Network Planning:** Introduction to cost control. Importance and objectives of cost control. Introduction to methods of cost analysis. Project cost and its variation with time. Cost optimization (with examples).	8
4.	**Environmental Management:** Introduction to the environmental management system. Preparation for EMS certification. Introduction to environmental	10

	legislation and its objective and importance. Introduction to environmental audit.	
5.	**Risk Management:** Introduction to risk and its importance in construction projects; types of risks – safety, financial, technical, environmental, and legal; risk identification and assessment methods; risk mitigation and control strategies; safety risk management and legal standards (IS codes); financial and environmental risks; preparation of a basic risk management plan with case studies.	7

COURSE OUTCOMES	
CO 1.	Give the Students an idea of construction management and its historical background.
CO 2.	Learner should be capable enough to analyse the project resources.
CO 3.	Learner should be able to make cost analysis with time variation
CO 4.	Learner should assess and calculates the impacts of construction on the environment.
CO 5.	Students will be able to identify, assess, and develop basic risk mitigation plans to handle site risks

TEXT BOOKS/REFERENCES		
S. No	**Book/Text Title**	**Author**
1.	Construction Planning and Management	P.S.Gahlot and B.M.Dhir.
2.	Construction Management and Accounts	Jagroop Sing.
3.	Environmental Engineering and Management	Dr.Suresh K. Dhameja.

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	5th
COURSE TITLE	Design Software
COURSE CODE	CIV-306-E
COURSE CATEGORY	Professional Elective Course (PEC)
ELECTIVE TRACK	Structural Engineering

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
3	2	1	0	0	45

COURSE OBJECTIVES	
1.	Know various techniques of modeling building structures
2.	To obtain knowledge of analyzing and designing various structural elements
3.	To gain knowledge of modeling and design of masonry buildings
4.	To obtain post-processing analysis and design report and to compare with manual calculations for validation of results
5.	Know various techniques of modeling building structures

COURSE CONTENT		
Units	**Description**	**Cont. Hours**
1.	**Introduction to ETABS Software:** File Menu, Defining material properties, Definition and Sizing of elements, Supports, Loading and Load Combinations, Analysis options, Post Analysis checks.	12
2.	**Modelling of Multi-Story Residential Modelling in ETABS Software:** Study of the design of various building elements; Planning various components of a building with column positioning; Introduction of /ETABS/; Modelling of the building in the /ETABS is giving all boundary conditions (supports, loading etc.).	8
3.	**Analysis of residential building by Multi-Story Residential Design by ETABS software:** Detailing of beams, columns, slab with section proportioning and reinforcement, Analysis of various structural components of the modal building; Study of analysis Data of the software.	8
4.	**Design of residential building by ETABS software:** Analysis and designing various types of footings- Isolated, Combined, Strap, Strip, and Mat in ETABS/ software.	10
5.	**Post Processing of Design Data:**	7

	Building Post-Processing Data related to bending, shear, Torsion, and displacements. Comparing different manual charts and software-based data.	

COURSE OUTCOMES	
CO 1.	To accomplish the abilities/skills for the following.
CO 2.	Recognizing the benefits of designing by Software.
CO 3.	Understanding various design techniques of different components of a Building.
CO 4.	Understanding various design techniques of different components of a Building
CO 5.	Gaining Knowledge of Post Processed design data for understanding of design problems

TEXT BOOKS/REFERENCES	
S. No	**Book/Text Title**
1.	Etabs tutorial, Computers and Structures USA
2.	U.H.Varyani. Structural Design of Multi Storeyed Building. 2014

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	6th
COURSE TITLE	Advanced Structural Analysis
COURSE CODE	CIV-356-E
COURSE CATEGORY	Professional Elective Course (PEC)
ELECTIVE TRACK	Structural Engineering

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
3	2	1	0	0	45

COURSE OBJECTIVES	
1.	Develop advanced proficiency in structural analysis techniques, including matrix methods.
2.	Explore complex structural systems and their behavior
3.	Apply structural analysis knowledge, including matrix analysis, to solve complex engineering problems.

COURSE CONTENT		
Units	**Description**	**Cont. Hours**
1.	**Matrix Methods Of Trusses Structural Analysis:** Introduction to matrices and properties of matrices, Concept of Matrix Method & Flexibility Method. Formulation of Stiffness matrix for simple Planar Elements, Analysis of Planar Trusses (basic).	10
2.	**Matrix Methods Of Beams And Frames:** Formulation of element stiffness matrix for beam/ frame element. Analysis of Beams (basic) and Frames (basic) using stiffness method under nodal and between the nodal loads.	12
3.	**Introduction To Finite Element Method (Fem):** Introduction to Finite Element Method of Structural Analysis. Problem Classification, Modelling, and Discretization. Interpolation, Elements, notes, and D.O.F. Example Applications and history of FEM. Solving problems by FEM.	13
4.	**One-Dimensional Elements And Computational Procedures** Bar and Beam Elements. Bar and Beam elements of arbitrary orientation. Assembly of Elements. Properties of Stiffness matrices. Boundary Conditions. Exploiting Sparsity. Solving Equations. Mechanical and thermal Loads or Stresses. Structural Symmetry.	10

COURSE OUTCOMES	
CO 1.	Demonstrate advanced proficiency in structural analysis techniques, including matrix analysis.
CO 2.	Analyze complex structural systems and predict their behavior.
CO 3.	Apply advanced methods, including matrix analysis, to solve complex engineering problems

TEXT BOOKS/REFERENCES	
S. No	**Book/Text Title**
1.	Chopra, A. K. (2014). Dynamics of Structures: Theory and Applications to Earthquake Engineering (5th ed.). Pearson.
2.	Clough, R. W., & Penzien, J. (2003). Dynamics of Structures (3rd ed.). McGraw-Hill Education.
3.	Ghali, A., & Neville, A. M. (2015). Structural Analysis: A Unified Classical and Matrix Approach (6th ed.). CRC Press

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	7th
COURSE TITLE	Design of Bridge Structures
COURSE CODE	CIV-405-E
COURSE CATEGORY	Professional Elective Course (PEC)
ELECTIVE TRACK	Structural Engineering

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
3	2	1	0	0	45

COURSE OBJECTIVES	
1.	Introduce the fundamentals of bridge engineering.
2.	Analyze and design bridge deck slabs and plate girder bridges.
3.	Design RCC slab culverts as per standard IRC provisions.

COURSE CONTENT		
Units	**Description**	**Cont. Hours**
1.	**Introduction to Bridges:** Classification of bridges and basic structural components. Types of loads and load combinations as per IRC Codes. Hydraulic design of bridges: Scour depth, afflux, and waterway requirements. Overview of bridge sub-structures.	12
2.	**Design of RCC Culverts:** Types of culverts and their functional aspects. Design of RCC slab culverts considering IRC loadings.	12
3.	**Design of Bridge Deck Slabs:** Analysis and design of RCC bridge deck slabs. Courbon's Method for load distribution in bridge decks.	11
4.	**Design of Plate Girder Bridges:** Introduction to plate girder bridges. Design of main girders, stiffeners, and cross-bracing. Shear and moment calculations in plate girders.	

COURSE OUTCOMES	
CO 1.	Understand bridge types, components, and loading conditions.
CO 2.	Analyze and design RCC slab culverts.
CO 3.	Design bridge deck slabs using standard methods.
CO 4.	Design plate girder bridges, considering shear, bending, and stiffening requirements.

TEXT BOOKS/REFERENCES		
S. No	**Book/Text Title**	**Author**
1.	Design of Bridges	Johnson Victor.
2.	Design of Bridges	Krishna Raju.
3.	Relevant IRC & IS Codes.	IRC & IS CODES

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	8th
COURSE TITLE	Pre-Stressed Concrete
COURSE CODE	CIV-451-E
COURSE CATEGORY	Professional Elective Course (PEC)
ELECTIVE TRACK	Structural Engineering

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
3	2	1	0	0	45

COURSE OBJECTIVES	
1.	Understand the principles and concepts of pre-stressed concrete construction.
2.	Develop the ability to design and analyze pre-stressed concrete structures.
3.	Gain knowledge of different pre-stressing methods and their applications

COURSE CONTENT		
Units	**Description**	**Cont. Hours**
1.	**Introduction to Pre-Stressed Concrete:** Overview of Pre-Stressed concrete as a construction material. Historical development and advantages of Pre-Stressed concrete. Basic principles of Pre-Stressing.	11
2.	**Pre-Stressed Concrete Design:** Design philosophy and safety considerations in Pre-Stressed concrete. Analysis and design of Pre-Stressed concrete members: beams, slabs, and columns. Design of Pre-Stressed concrete bridges.	12
3.	**Pre-Stressing Methods :** Introduction to different Pre-Stressing methods: pre-tensioning and post-tensioning. Applications and advantages of each Pre-Stressing method. Case studies of Pre-Stressed concrete projects.	12
4.	**Practical Applications:** Design projects involving Pre-Stressed concrete structures. Real-world engineering challenges in Pre-Stressed concrete design. Group projects to design and analyze Pre-Stressed concrete structures	10
5.	**Introduction to Pre-Stressed Concrete:** Overview of Pre-Stressed concrete as a construction material. Historical development and advantages of Pre-Stressed concrete. Basic principles of Pre-Stressing.	11

COURSE OUTCOMES	
CO 1.	Explain the principles and concepts of pre-stressed concrete construction.
CO 2.	Design and analyze pre-stressed concrete structures
CO 3.	Describe different pre-stressing methods and their applications.

TEXT BOOKS/REFERENCES	
S. No	**Book/Text Title**
1.	Nilson, A. H., Darwin, D., & Dolan, C. W. (2015). Design of Pre-stressed Concrete (3rd ed.). Wiley.
2.	PCI (Precast/Pre-stressed Concrete Institute). (2016). PCI Design Handbook: Precast and Pre-stressed Concrete (8th ed.). PCI.
3.	ACI Committee 318. (2014). Building Code Requirements for Structural Concrete (ACI 318-14) and Commentary. American Concrete Institute

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	3rd
COURSE TITLE	Introduction to Geotechnical Engineering
COURSE CODE	CIV-207-E
COURSE CATEGORY	Professional Elective Course (PEC)
ELECTIVE TRACK	Geo-Technical Engineering

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
3	2	1	0	0	45

COURSE OBJECTIVES	
1.	Understand the basic principles and applications of soil mechanics in civil engineering.
2.	Familiarize with simple soil testing methods and their practical uses.
3.	Learn the significance of soil behavior in construction projects.
4.	Prepare for site-related decision-making and advanced geotechnical courses.

COURSE CONTENT		
Units	**Description**	**Cont. Hours**
1.	**Introduction to Soil Mechanics and Soil Classification:** Importance of soil in civil engineering projects. Types of soils, their origin, and field identification. Soil properties: Water content, density, void ratio. Simple soil. Classification and application in projects.	12
2.	**Soil Moisture, Permeability, and Seepage (Field Applications):** Role of water in soil strength and stability. Practical understanding of permeability and seepage. Applications in drainage and water control in construction.	8
3.	**Soil Compaction and its Practical Importance:** Purpose and field techniques of compaction. Proctor test concept and optimum moisture content. Compaction in earthworks, roads, and embankments.	8
4.	**Shear Strength, Bearing Capacity & Settlement (Introduction):** Introduction to soil strength, failure concepts. Field testing methods like direct shear test (conceptual). Settlement impact on structures and its control.	10
5.	**Earth Pressure, Slopes, and Site Investigation Basics:**	7

	Application of earth pressure concepts in retaining structures. Slope stability issues and basic prevention methods. Simple soil exploration methods, SPT introduction.	

COURSE OUTCOMES	
CO 1.	**Classify soil types and basic physical properties.**
CO 2.	Perform simple field and lab tests for soil behaviour assessment.
CO 3.	**Understand the importance of permeability, compaction, and strength in construction.**
CO 4.	Apply basic geotechnical knowledge in field applications like earthworks and foundations.

TEXT BOOKS/REFERENCES	
S. No	**Book/Text Title**
1.	B.C. Punmia et al., "Soil Mechanics and Foundations", Laxmi Publications.
2.	Gopal Ranjan & A.S.R. Rao, "Basic and Applied Soil Mechanics", New Age International.
3.	V.N.S. Murthy, "Soil Mechanics and Foundation Engineering", CBS Publishers.

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	4th
COURSE TITLE	Engineering Geology and Seismology
COURSE CODE	CIV-256-E
COURSE CATEGORY	Professional Elective Course (PEC)
ELECTIVE TRACK	Geo-Technical Engineering

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
3	2	1	0	0	45

COURSE OBJECTIVES	
1.	Geological considerations in the design of tunnels, dams, and buildings
2.	To provide a coherent development to the students for the courses in the sector of earthquake engineering
3.	To present the foundations of many basic engineering concepts related to earthquake Engineering
4.	To give experience in the implementation of engineering concepts that are applied in the field of earthquake engineering

COURSE CONTENT		
Units	**Description**	**Cont. Hours**
1.	Geology and its relevance to civil engineering, Structural Geology; Folds, Faults and Mechanism of Faulting, Joints, Unconformities.	12
2.	Engineering Geology; geological considerations in tunnels, dams, bridges, building sites; landslides.	8
3.	Earthquakes; types and causes, distribution in the world, basic definitions, seismic zones.	8
4.	Engineering Seismology (Definitions), Introduction to Seismic Hazards and Earthquake Phenomenon. Geographical Distribution of Earthquakes and Seismo-techtonics.	10
5.	Earthquake recording instruments, Warning systems, Global network, Monitoring of Earthquake.	7

COURSE OUTCOMES	
CO 1.	Show an understanding of the physical properties used to identify Earth materials.
CO 2.	Show an understanding of the geomorphic processes that modify the Earth's surface**.**

CO 3.	Examine the various geological engineering problems faced in the design of dams, tunnels, and buildings.
CO 4.	Gain experience in Earthquake Engineering's implementation of engineering concepts applied in the field of Structural Engineering.
CO 5.	Learn to understand the theoretical and practical aspects of earthquake engineering.

TEXT BOOKS/REFERENCES	
S. No	**Book/Text Title**
1.	Engineering Geology by Parbin Singh
2.	Physical Geology by Arthur Holmes
3.	Engineering Geology by F.G. Bell
4.	Engineering Seismology by PN Aggarwal
5.	An introduction to Seismology, Earthquakes & Earth Structures by Sethstein & Michael Wysession

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	5th
COURSE TITLE	Geotechnical Applications in Construction
COURSE CODE	CIV-307-E
COURSE CATEGORY	Professional Elective Course (PEC)
ELECTIVE TRACK	Geo-Technical Engineering

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
3	2	1	0	0	45

COURSE OBJECTIVES	
1.	Understand the practical geotechnical aspects involved in construction projects.
2.	Identify simple ground improvement techniques and construction challenges related to soil.
3.	Recognize the role of geotechnical inputs in roads, foundations, and earthworks.
4.	Assess soil-related construction problems and propose basic field solutions.
5.	Develop an understanding of geotechnical needs in common infrastructure projects.

COURSE CONTENT		
Units	**Description**	**Cont. Hours**
1.	**Geotechnical Inputs in Construction Projects:** Importance of geotechnical studies, soil reports, bore logs, water table effects, and basic field tests.	12
2.	**Ground Preparation and Earthworks:** Earthwork planning, compaction methods, dewatering, challenges during earthworks, and subgrade preparation.	8
3.	**Ground Improvement Techniques:** Compaction, sand replacement, stone columns, Geosynthetics, stabilization methods, and field applications.	8
4.	**Foundation Systems – Construction Perspective:** Overview of shallow and deep foundations, site issues, quality checks, and examples from infrastructure projects.	10
5.	**Retaining Structures, Slope Stability, and Construction Challenges:** Basics of earth pressure, retaining structures, slope failures, soil nails, gabions, and geotechnical failures case studies.	7

COURSE OUTCOMES	
CO 1.	Explain the relevance of geotechnical investigations in construction projects.

CO 2.	Identify simple ground improvement methods used in construction.
CO 3.	Understand basic foundation systems and field issues during execution.
CO 4.	Recognize common soil-related problems in infrastructure projects.
CO 5.	Apply practical geotechnical knowledge to real-world construction scenarios.

TEXT BOOKS/REFERENCES		
S. No	**Book/Text Title**	**Author**
1.	Analytical & computational Methods in Engineering Rock Mechanic	Brown, E.T, CBS Publishers & Distributors, New Delhi
2.	Introduction to Rock Mechanics	Godman, P.E., John Wiley, 1989.

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	6th
COURSE TITLE	Rock Mechanics & Tunneling Technology
COURSE CODE	CIV-357-E
COURSE CATEGORY	Professional Elective Course (PEC)
ELECTIVE TRACK	Geo-Technical Engineering

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
3	2	1	0	0	45

COURSE OBJECTIVES	
1.	To understand the formation of Rock, Classification, characterization, etc.
2.	To learn about the stability of rock slopes.
3.	To understand the factors governing the selection of type and location of the tunnels.
4.	To gain a comprehensive understanding of the planning and design of Tunnels.
5.	To learn the construction practices and the associated challenges.

COURSE CONTENT		
Units	**Description**	**Cont. Hours**
1.	Introduction, terminology, Rock classification systems, physical & Mechanical properties of rocks, laboratory testing, stability of rock slopes, Rock bolting.	10
2.	Introduction, Classification of tunnels. Survey for a tunnel project.	9
3.	Methods of Tunnelling in soft & hard rock. Methods of rock blasting in tunnels.	10
4.	Tunnel services in rock tunnels, ventilation, drainage, and lighting.	6
5.	Lining of tunnels in soft grounds methods and types, tunnel supports for weak rocks including rock bolting.	10

COURSE OUTCOMES	
CO 1.	Competence in Rock Mass Characterization
CO 2.	Competence in deciding the location of tunnels, type of tunnels and method of tunnelling.
CO 3.	Ability to analyse different components of the Tunnels and tunnel support systems.

TEXT BOOKS/REFERENCES	
S. No	**Book/Text Title**
1.	Chopra, A. K. (2014). Dynamics of Structures: Theory and Applications to Earthquake Engineering (5th ed.). Pearson.
2.	Clough, R. W., & Penzien, J. (2003). Dynamics of Structures (3rd ed.). McGraw-Hill Education.
3.	Ghali, A., & Neville, A. M. (2015). Structural Analysis: A Unified Classical and Matrix Approach (6th ed.). CRC Press

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	7th
COURSE TITLE	Geo-Environmental Engineering
COURSE CODE	CIV-406-E
COURSE CATEGORY	Professional Elective Course (PEC)
ELECTIVE TRACK	Geo-Technical Engineering

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
3	2	1	0	0	45

COURSE OBJECTIVES	
1.	Understand the fundamentals of Geoenvironmental engineering and the interaction of soil, water, and environmental factors with a focus on waste management and its environmental impact.
2.	Study the geotechnical utilization of various waste materials and understand site selection parameters and regulations for waste disposal facilities.
3.	Learn about landfill design, layout, and the function of components such as liners and cover systems, including soil selection and construction methods.
4.	Understand the design and management of leachate and gas collection systems and explore the use of Geosynthetics in landfill engineering.
5.	Learn various soil investigation and remediation techniques for managing contaminated sites, including physical, chemical, biological, and electro kinetic methods.

COURSE CONTENT		
Units	**Description**	**Cont. Hours**
1.	**Introduction and Soil-water-environment interaction:** Introduction to Geoenvironmental, Engineering, Soil-water-environment interaction relating to geotechnical problems, Waste:- source, classification and management of waste, Physical, chemical and geotechnical characterization of municipal solid waste, Impact of waste dump and its remediation	12
2.	**Geotechnical application of waste and disposal:** Geotechnical use of different types such as Thermal power plant waste, MSW, mine waste, industrial waste. Waste disposal facilities, Parameters controlling the selection of site for sanitary and industrial landfill. Site characterization. MoEF guidelines.	12
3.	**Landfill Components:** Landfill layout and capacity, components of landfill and its functions. Types and functions of liner and cover systems, Compacted clay liner, selection of soil for liner, methodology of construction.	8

4.	**Leachate, Gas Management and Geosynthetics:** Management of Leachate and gas. Various components of leachate collection and removal system and its design. Gas disposal/utilization. Closure and post closure monitoring system Geosynthetics- Geo-membranes - Geosynthetics clay liners -testing and design aspects.	7
5.	**Soil remediation :** Investigation of contaminated soil, sampling, assessment Transport of contaminants in saturated soil. Remediation of contaminated soil-in-situ / exit remediation, bio remediation, thermal remediation, pump and treat method, phytoremediation and electro-kinetic remediation.	6

COURSE OUTCOMES	
CO 1.	Students will be able to explain soil-water-environment interaction and assess the impact of various types of waste dumping on geotechnical problems and the environment.
CO 2.	Students will be able to evaluate the suitability of waste materials for geotechnical applications and analyze site selection criteria for landfills based on environmental guidelines.
CO 3.	Students will be able to design landfill components including liner systems and determine the appropriate construction methodology and soil requirements for effective containment.
CO 4.	Students will be able to design leachate and gas management systems and select suitable Geosynthetics for landfill applications to ensure environmental safety.
CO 5.	Students will be able to investigate contaminated soils and recommend appropriate remediation techniques

TEXTBOOK REFERENCES	
1.	Daniel, D.E. (1993). Geotechnical Practice for Waste Disposal. Chapman, and Hall, London.
2.	Koerner, R.M. (2005). Designing with Geosynthetics. Fifth Edition. Prentice Hall, New Jersey.
3.	Dr. G V Rao and Dr. R S Sasidhar (2009) Solid waste Management and Engineered Landfills, Saimaster Geoenvironmental Services Pvt. Ltd. Publication.
4.	Reddi L.N and Inyang HI (2000) Geoenvironmental Engineering: Principles and Applications, Marcel Dekker Inc Publication
5.	Ayyar TSR (2000) Soil engineering in relation to environment, LBS center for Science and Technology, Trivandrum.

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	8th
COURSE TITLE	Ground Improvement Techniques
COURSE CODE	CIV-452-E
COURSE CATEGORY	Professional Elective Course (PEC)
ELECTIVE TRACK	Geo-Technical Engineering

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
31	2	1	0	0	45

COURSE OBJECTIVES	
1.	To introduce students to the challenges posed by problematic soils and the need for ground improvement techniques.
2.	To familiarize students with various mechanical ground improvement methods and their practical applications.
3.	To develop an understanding of seepage control and dewatering techniques in the field.
4.	To expose students to physical, chemical, and thermal modification methods such as grouting, concreting, and guniting.
5.	To impart knowledge about specialized techniques like ground anchoring, rock bolting, and soil nailing for ground stabilization.

COURSE CONTENT		
Units	**Experiments**	**Cont. Hours**
1.	**Introduction:** Soil Types, Soil Investigation & Classification, Ground Modification/Stabilization, Need for Engineered Ground Improvement, Classification of Ground Improvement Techniques, Suitability, Feasibility and Desirability of Ground Improvement Techniques, Current & Future Developments.	7
2.	**Ground Improvement Techniques Mechanical Modification:** Introduction to Mechanical Modification, Principles of Soil Densification, Properties of Compacted Soil, Compaction Control, Specification of Compaction, Requirements, Types of Compaction Equipment.	10
3.	**Hydraulic Modification:** Objectives & Techniques, Dewatering Systems, Soil-Water Relationships, Single& Multiple-Well Formulas, Drainage of Slopes, Filtration & Seepage Control, Preloading & Vertical Drains, Electro kinetic Dewatering & Stabilization.	8

4.	**Chemical Modification/Stabilization:** Effect of various admixtures on Engineering Properties of Soils such as Cement, Lime, Fly ash, Bitumen, Cement Lime Fly ash. Other chemical additives such as NaCL, CaCL2 ,CaSO4 , Ca (OH)2,	10
	NaOH etc., Grouting- Applications to Embankments, Foundations& Sensitive Soils, Admixtures in Pavement Design.	
5.	**Thermal Modification:** Thermal Properties of Soils, Heat Treatment of Soils, Ground Freezing, Strength & Behaviour of Frozen Ground. Modification By Inclusions & Confinement: Evolution of Soil Reinforcement, Applications of Geosynthetics Material in Civil Engineering, Soil Nailing, Soil Anchors, Soil Confinement by Formwork.	10

COURSE OUTCOMES	
CO 1.	Analyze the field problems related to problematic soils and solve the problems using the ground improvement techniques.
CO 2.	Summarize and practice ground improvement using Mechanical modification techniques.
CO 3.	Design drainage for seepage control, assess dewatering field problems.
CO 4.	Application of physical and chemical ground improvement techniques using thermal modification, like grouting, shotcreting and guniting technology.
CO 5.	Demonstrate the ground improvement techniques such as ground anchors, rock bolting and soil nailing.

TEXT BOOKS/REFERENCES		
S. No	**Book/Text Title**	**Author**
1.	Methods of Treatment of Unstable Ground	Belt – Butterworths, 1975
2.	Engineering Principles of Ground Modification	Manfired, R. H.
3.	Engineering Treatment of Soils	Bell, F. G
4.	Geosynthetics for Soil Improvement	ASCE, GST No. 18,New York
5.	Grouting Theory & Practice	Nonveiller, E
6.	Soil Stabilization	Ingles, O. G. &Metcalf, J. B

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	3rd
COURSE TITLE	**Introduction to Green Technology**
COURSE CODE	CIV-208-E
COURSE CATEGORY	Professional Elective Course (PEC)
ELECTIVE TRACK	Environmental Engineering

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
3	2	1	0	0	45

COURSE OBJECTIVES	
1.	Understand the basic concepts, significance, and need for green technology in addressing global environmental challenges.
2.	Explore sustainable materials and renewable resources to minimize environmental impacts.
3.	Learn various green energy systems and energy conservation technologies for sustainable development.
4.	Gain knowledge of waste management strategies and pollution control techniques for environmental protection.

COURSE CONTENT		
Units	**Topic**	**Cont. Hours**
1.	**Introduction to Green Technology:** Definition, scope, and significance of green technology. Global environmental issues and need for green technology. Overview of renewable energy, waste minimization, and pollution control technologies.	8
2.	**Green Materials and Sustainable Resources:** Sustainable materials and renewable resources. Recycling, reuse, and life-cycle of materials. Eco-friendly building materials and technologies.	8
3.	**Green Energy Systems:** Renewable energy sources: solar, wind, hydro, biomass, geothermal. Energy-efficient technologies. Smart grids and energy conservation techniques.	9
4.	**Waste Management and Pollution Control:** Waste minimization and management strategies. Solid waste, e-waste, hazardous waste management. Air, water, and soil pollution control technologies.	10
5.	**Applications and Future of Green Technology:** Green buildings and sustainable urban planning.	10

	Green transportation and agriculture. Future trends, government initiatives, and green policies.	

COURSE OUTCOMES	
CO 1.	Explain the importance, principles, and scope of green technology in solving environmental problems.
CO 2.	Select and recommend sustainable materials and renewable resources for various applications.
CO 3.	Describe different green energy systems and evaluate their impact on sustainability.
CO 4.	Analyze waste management practices and pollution control technologies used in green solutions.
CO 5.	Evaluate green technology applications in sectors like buildings, transportation, agriculture, and predict future developments.

TEXT BOOKS/REFERENCES	
S. No	**Book/Text Title**
1.	Rao, P.K. - Introduction to Green Technologies
2.	Kibert, C.J. - Sustainable Construction: Green Building Design and Delivery
3.	USGBC - LEED Reference Guide for Green Building
4.	Sharma, B.K. - Environmental Chemistry
5.	Haapio, A., & Viitaniemi, P. - Environmental Impact Assessment Review

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	4th
COURSE TITLE	**Environmental Pollution and Control**
COURSE CODE	CIV-257-E
COURSE CATEGORY	Professional Elective Course (PEC)
ELECTIVE TRACK	Environmental Engineering

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
3	2	1	0	0	45

COURSE OBJECTIVES	
1.	Understand the fundamental concepts of environmental pollution and its types.
2.	Study the effects of pollutants on environment and health.
3.	Learn techniques and systems for pollution control.
4.	Understand waste management, noise, and thermal pollution control.
5.	Familiarize with environmental laws, regulations, and sustainable development practices.

COURSE CONTENT		
Units	**Topic**	**Cont. Hours**
1.	**Introduction to Environmental Pollution:** Definition and classification of pollution. Sources and effects of various pollutants (air, water, soil, noise, thermal, radioactive). Impact of pollution on human health and ecosystems. Introduction to environmental sustainability and global concerns (Climate change, ozone depletion).	9
2.	**Air Pollution and Control:** Sources and types of air pollutants. Effects of air pollution on health, vegetation, materials, and climate. Air quality standards (NAAQS) and air quality index (AQI). Air pollution control devices: Settling chambers, Cyclone separators, Filters, ESP, Scrubbers. Vehicular pollution and control measures.	9
3.	**Water Pollution and Control:** Sources and classification of water pollutants. Effects of water pollution on environment and health. Water quality standards (IS codes). Wastewater treatment: Primary, Secondary, and Tertiary methods. Introduction to CETP and STP (Common Effluent and Sewage Treatment Plants).	9

4.	**Solid Waste, Soil, Noise, and Thermal Pollution:** Types and sources of solid waste (municipal, industrial, hazardous, e-waste, biomedical waste). Methods of collection, transportation, and disposal of solid waste. Land/soil pollution causes and control measures. Noise pollution: Sources, effects, measurement, and control methods. Thermal pollution: Causes, effects, and control.	9
5.	**Environmental Management, Laws, and Sustainable Practices:** Environmental policies and acts: Water Act, Air Act, Environment Protection Act (EPA), 1986. Role of regulatory agencies (CPCB, SPCBs). Environmental Impact Assessment (EIA): Basics and process Climate change and global protocols (Kyoto, Paris Agreement). Introduction to sustainability, green technology, and the 3R concept (Reduce, Reuse, And Recycle).	9

COURSE OUTCOMES	
CO 1.	Classify different types of pollution and identify major sources.
CO 2.	Analyze environmental and health impacts of various pollutants.
CO 3.	Suggest appropriate pollution control measures for air, water, and land.
CO 4.	Recommend proper waste management techniques and noise mitigation measures.
CO 5.	Interpret environmental policies, acts, and standards relevant to pollution control.

TEXT BOOKS/REFERENCES	
S. No	**Book/Text Title**
1.	C.S. Rao, Environmental Pollution Control Engineering, Wiley Eastern Ltd.
2.	Peavy, Rowe, and Tchobanoglous, Environmental Engineering, McGraw Hill.
3.	Garg, S.K., Environmental Engineering Vol. I & II, Khanna Publishers.
4.	CPCB Guidelines and MoEFCC Reports

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	5th
COURSE TITLE	**Solid Waste Management**
COURSE CODE	CIV-308-E
COURSE CATEGORY	Professional Elective Course (PEC)
ELECTIVE TRACK	Environmental Engineering

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
3	2	1	0	0	45

COURSE OBJECTIVES	
1.	To develop required skills in the students to acquire the following competency: Plan segregation, collection, transportation, recycling, and disposal of municipal solid waste so that its impact is minimal on the environment, economy and community.

COURSE CONTENT		
Units	**Topic**	**Cont. Hours**
1.	**Sources and Composition of Municipal Solid Waste**: Sources of solid waste. Types of solid waste. Characteristics of Solid waste, composition of solid waste and its determination.	4
2.	**Properties of Municipal Solid Waste** : Physical properties of Municipal Solid Waste, Chemical properties of Municipal Solid Waste, Biological properties of Municipal Solid Waste and Transformation of Municipal Solid Waste.	6
3.	**Solid Waste Generation and Collection**: Quantities of Solid Waste, Measurements, and methods to measure solid waste quantities. Solid waste generation and collection, Factors affecting solid waste generation rate, Quantities of materials recovered from MSW**.**	6
4.	**Handling, Separation, and Storage of Solid Waste:** Handling and separation of solid waste at site. Material separation by pick in, screens, float and separator magnets, and electromechanical separator, and other latest devices for material separation. Waste handling and separation at Commercial and industrial facilities. Storage of solid waste at the sources.	7
5.	**Processing and disposal of Solid Waste:** Processing of solid waste at residence e.g. Storage, conveying, compacting, Shredding, pulping, granulating etc. Combustion and energy recovery of municipal solid waste, effects of combustion, undesirable effects of Combustion, Landfill: Classification, planning, sitting, permitting, landfill processes, landfill design, landfill operation, use Of old landfill, Differentiate sanitary land fill and incineration as final disposal system for solid waste, Biochemical	7

	processes: Methane generation by anaerobic digestion, composting and other biochemical Processes.	

COURSE OUTCOMES	
CO 1.	Explain municipal solid waste management systems to their physical properties and associated critical considerations in view of emerging technologies
CO 2.	Outline sources, types and composition of so lid waste with methods of handling, sampling and storage of solid waste.
CO 3.	Select the appropriate method for solid waste collection, transportation and redistribution.
CO 4.	Describe methods of disposal of municipal solid waste.

TEXT BOOKS/REFERENCES		
S. No	**Book/Text Title**	**Author**
1.	Solid Waste Technology & Management	Christensen, H. T. Wiley, 2010, Volume 1 & 2.
2.	The Practical Handbook of Compost Engineering	Haug, T. R, Lewis Publishers, 1993.
3.	Landfill Bioreactor Design & Operation,	Reinhart, R. D. and Townsend, G. T., CRC Press, 1997, 1st Edition.
4.	Handbook Of Solid Waste Management	4Tchobanoglous, G. and Kreith, F., McGraw Hill, 2002, 2nd Edition.
5.	Integrated Solid Waste Management: Engineering Principles and Management Issues	Tchobanoglous, G., Theisen and Vigil, Issues, McGraw Hill, 1993.
6.	Manual on Municipal 1 Solid waste Management	CPHEEO, Ministry of Urban Development, Govt. Of. India, New Delhi, 2000.

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	6th
COURSE TITLE	Climate Change: Impacts, Adaptation, and Resilience in Civil Engineering
COURSE CODE	CIV-358-E
COURSE CATEGORY	Professional Elective Course (PEC)
ELECTIVE TRACK	Environmental Engineering

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
3	2	1	0	0	45

COURSE OBJECTIVES	
1.	To understand climate change science, international frameworks, and their relevance to civil engineering.
2.	To analyse the vulnerability of civil infrastructure to various climate change effects.
3.	To explore engineering design and adaptation strategies enhancing climate resilience of civil infrastructure.
4.	To study sustainable materials, green technologies, and tools aiding low-carbon infrastructure.
5.	To introduce codes, policies, and upcoming technologies promoting climate resilience in civil projects.

COURSE CONTENT		
Units	**Topic**	**Cont. Hours**
1.	**Introduction to Climate Change and Civil Engineering:** Basics of Climate Science: Carbon cycle, Greenhouse effect, Global warming Climate Change Evidence: IPCC Reports, global and regional trends of climate variables, accelerated glacial melt, sea level rise, Civil Engineering sectors impacted by climate change Overview of International Policies: UNFCCC, Paris Agreement, Kyoto Protocol. National Action Plans on Climate Change (NAPCC) and relevance to infrastructure. Climate risk assessment framework for civil engineers	10
2.	**Climate Projections:** Changes in Atmospheric Constituents and Radiative Forcing Global Climate Models Representative Concentration Pathways Climate Projections - Global and Regional	7

3.	**Impacts of Climate Change on infrastructure:** Vulnerabilities of different infrastructure types: Transportation, Buildings, Energy Systems, Water Systems Material degradation under changing climate conditions	8
	Coastal and marine infrastructure challenges Impact on construction activities and safety	
4.	**Climate Change Adaptation Strategies in Civil Engineering** Concepts of resilience, mitigation and adaptation Climate resilient development Engineering solutions for climate adaptation Flood-proofing, heat stress management, green roofs Retrofitting and rehabilitation for resilience Smart cities and climate-resilient planning	10
5.	**Policy Frameworks, Codes.** Global and national policy initiatives Climate change in design codes and standards Disaster risk reduction frameworks International cooperation and Finances	10

COURSE OUTCOMES	
CO 1.	Students will be able to explain climate change mechanisms and identify civil engineering sectors affected.
CO 2.	Students will evaluate climate-related risks to different infrastructure systems and materials.
CO 3.	Students will propose suitable adaptation techniques for climate-resilient infrastructure projects.
CO 4.	Students will assess and recommend eco-friendly materials and green infrastructure for civil engineering use.
CO 5.	Students will interpret climate change-related policies, design standards, and future trends in the field.

TEXT BOOKS/REFERENCES		
S. No	**Book/Text Title**	**Author**
1.	Climate Adaptation Engineering: Risks and Solutions	Juan A. Blanco, Houshang Kheradmand
2.	Infrastructure Resilience to Climate Change	Sreevalsa Kolathayar, Ashok Kumar
3.	Sustainable Construction Materials and Technologies	Yoon-Moon Chun, S. Nagataki
4.	Green Infrastructure: Linking Landscapes and Communities	Mark A. Benedict, Edward T. McMahon

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	7th
COURSE TITLE	**Environment Impact Assessment & Audit**
COURSE CODE	CIV-407-E
COURSE CATEGORY	Professional Elective Course (PEC)
ELECTIVE TRACK	Environmental Engineering

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
3	2	1	0	0	45

COURSE OBJECTIVES	
1.	To gain knowledge about different types of environmental pollution and their control measures.
2.	Understand the pollution monitoring aspects of air, soil, water, and noise pollution.
3.	Know about Environmental audit and Environmental Impact Assessment.

COURSE CONTENT		
Units	**Topic**	**Cont. Hours**
1.	**Environment and Pollution:** Basic ideas of environment, basic concepts, man, society & environment, their interrelationship Air Pollutants: Types, Sources, Effects; Air Pollution Meteorology: Lapse Rate, Inversion. Engineered Control of Air Pollutants. Definition of noise, effect of noise pollution, noise classification, Noise pollution control.	7
2.	**Water and Soil Pollution:** Methods of monitoring and control of water, soil Pollution; effects of pollution on plants, animals and Human beings. Sources, measurement, Effects, and control of Soil pollution.	6
3.	**Global Environmental Issues:** Green House Effect, Global Warming, Acid Rain, Ozone Layer Depletion, Nuclear Accidents, and Holocaust.	4
4.	**Environmental Impact Assessment:** Environmental laws and protection act of India, Definition, significance, and scope of impact assessment, Need & objective, types of environmental impacts, methods of environmental impacts, major steps in the impact assessment procedure, generalized approach to impact analysis, social impact assessment.	7

5.	**Environmental audit:** Recent trends in industrial waste management, Cradle to grave concept, Life cycle analysis, Clean technologies; Environmental audit:	6
	Definition and concepts, Environmental audit versus accounts audit, Compliance audit, Relevant methodologies, Various pollution regulations, Introduction to ISO and ISO 14000.	

COURSE OUTCOMES	
CO 1.	Aware and sensitise about the present days environmental issues at global and local scale.
CO 2.	Get acquainted with environmental and social impacts of any developmental activity.
CO 3.	Awareness of pollution monitoring aspects of air, soil, water and noise pollution.
CO 4.	Knowledge about environmental impact assessment with its objectives and procedure.

TEXT BOOKS/REFERENCES		
S. No	**Book/Text Title**	**Author**
1.	Environmental Engineering: A Design Approach	A. Sincero, G. Sincero PHI
2.	Environmental Engineering	P. V. Rowe TMH
3.	Environmental Engineering	S.K . Garg, Khanna Publishers
4.	Air Polution Rao and Rao TMH 4 Water Supply, Waste Disposal and Environmental Pollution Engineering	, A.K.Chatterjee Khanna Publishers
5.	Environmental Engineering, Vol.II	Rajagopalan Oxford University Press.

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	8th
COURSE TITLE	**Sustainable Environmental Practices and Quality Control**
COURSE CODE	CIV-253-E
COURSE CATEGORY	Professional Elective Course (PEC)
ELECTIVE TRACK	Environmental Engineering

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
3	2	1	0	0	45

COURSE OBJECTIVES	
1.	To impart knowledge of sustainable environmental practices and the importance of resource conservation in environmental engineering projects.
2.	To familiarize students with various types of pollution, control measures, and sustainable treatment technologies.
3.	To develop an understanding of quality control, monitoring, and environmental management systems in engineering projects.
4.	To introduce students to sustainable construction materials, techniques, and their cost-benefit analysis for infrastructure development.
5.	To expose students to recent innovations, global case studies, and future trends in environmental sustainability and the role of civil engineers in sustainable development.

COURSE CONTENT		
Units	**Topic**	**Cont. Hours**
1.	**Introduction to Sustainable Environmental Practices:** Concept and Need for Sustainability in Environmental Engineering. Sustainable Development Goals (SDGs) and Environmental Protection. Resource Conservation: Energy, Water, and Raw Materials. Waste Minimization and Recycling Principles. Green Building Concepts and Sustainable Construction Practices.	10
2.	**Environmental Pollution and Control Measures:** Air, Water, Soil, and Noise Pollution: Sources and Impacts. Pollution Control Strategies and Technologies. Sustainable Wastewater Treatment and Reuse. Solid Waste Management: Segregation, Recycling, and Composting. Sustainable Transportation Systems. Environmental Legislations and Guidelines (National and International Perspectives).	12

3.	**Quality Control in Environmental Engineering Projects:** Quality Control and Quality Assurance (QC & QA) Concepts. Material Quality Standards in Environmental Projects. Monitoring Tools and Techniques for Air, Water, and Soil Quality. Laboratory and Field Testing Methods. ISO Standards and Environmental Management Systems (EMS). Risk Assessment and Environmental Auditing.	08
4.	**Sustainable Construction Materials and Techniques:** Selection and Use of Eco-friendly Construction Materials. Recycled Aggregates, Fly Ash, GGBS, and Industrial By-products. Green Concrete and Sustainable Pavement Materials. Case Studies on Sustainable Material Use in Infrastructure Projects. Cost-Benefit Analysis of Sustainable vs Conventional Materials. Carbon Footprint Reduction Strategies in Construction.	7
5.	**Recent Innovations, Case Studies, and Future Trends:** Role of IoT, AI, and Smart Systems in Environmental Quality Monitoring. Renewable Energy Applications in Environmental Practices. Global Case Studies on Successful Sustainable Projects. Climate Change Mitigation and Adaptation Practices. Role of Civil Engineers in Promoting Sustainable Development. Future Scope and Emerging Trends in Environmental Sustainability.	8

COURSE OUTCOMES	
CO 1.	Explain the concept of sustainability, SDGs, and principles of circular economy in environmental engineering.
CO 2.	Identify sources of pollution and recommend appropriate sustainable pollution control and waste management strategies.
CO 3.	Apply quality control measures, environmental monitoring tools, and risk assessment techniques in environmental engineering projects.
CO 4.	Analyze the use of eco-friendly construction materials, green technologies, and assess their environmental and economic impact.
CO 5.	Evaluate recent innovations, smart systems, and global practices in environmental sustainability and apply them to climate change mitigation and adaptation.

TEXT BOOKS/REFERENCES	
S. No	**Book/Text Title**
1.	Environmental Engineering and Sustainable Design – *Ram S. Gupta*, CRC Press, Taylor & Francis Group
2.	Sustainable Construction: Green Building Design and Delivery – *Charles J. Kibert*, Wiley
3.	Environmental Pollution Control Engineering – *C.S. Rao*, New Age International Publishers

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	3rd
COURSE TITLE	Introduction to Water Supply & Sanitation
COURSE CODE	CIV-209-E
COURSE CATEGORY	Professional Elective Course (PEC)
ELECTIVE TRACK	Hydrology and Water Resource Engineering

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
3	2	1	0	0	45

COURSE OBJECTIVES	
1.	Understand the Fundamentals of Water Supply and Sanitation
2.	Analyze Water Demand, Supply, and Treatment Technologies
3.	Examine Water Distribution and Infrastructure Management
4.	Understand Sanitation Systems and Wastewater Treatment
5.	Address Environmental, Social, and Economic Aspects of Water and Sanitation
6.	Evaluate Policies, Governance, and Sustainable Development Strategies
7.	Explore Emerging Trends and Future Challenges

COURSE CONTENT		
Units	**Topic**	**Cont. Hours**
1.	**Introduction to Water Supply and Sanitation:** Importance of Water Supply and Sanitation; Overview of Water Resources, Surface water: Rivers, lakes, reservoirs, Groundwater: Wells, aquifers, springs, Alternative sources: Desalination, rainwater harvesting. Waterborne Diseases and Public Health Impacts, Waterborne pathogens (bacteria, viruses, protozoa), Common diseases: Cholera, typhoid, dysentery. Global and National Policies on Water and Sanitation, UN Sustainable Development Goal 6, WHO Guidelines for Drinking Water Quality, Water laws and policies in different countries	12
2.	**Water Supply Systems:** Water Demand and Supply Planning, Population growth and water demand estimation, Water conservation and efficiency; Water Sources and Collection Methods, Surface water abstraction and groundwater extraction, Source protection and contamination risks (introduction only) Water Treatment Processes, Coagulation, sedimentation, filtration, Disinfection methods: Chlorination, UV, ozonation; Water Distribution Systems, Transmission and distribution networks, Storage reservoirs and pumping systems, Leakage control and non-revenue water	8

3.	**Sanitation Systems and Wastewater Management:** Sanitation System Types and Technologies, On-site sanitation: Pit latrines, septic tanks, dry toilets, Off-site sanitation: Sewerage systems,	8
	centralized treatment; Wastewater Collection and Conveyance, Sewer networks: Design and maintenance, Combined vs. separate sewer systems. Wastewater Treatment Processes, Primary treatment: Sedimentation and screening, Secondary treatment: Activated sludge, trickling filters, anaerobic digestion, Tertiary treatment: Filtration, nutrient removal, disinfection	
4.	**Environmental and Social Aspects of Water and Sanitation:** Environmental Impacts of Water Supply and Sanitation, Water pollution and ecosystem damage, Climate change effects on water resources. Sustainable Water and Sanitation Practices, Integrated Water Resource Management (IWRM), Circular economy in wastewater treatment; Social and Cultural Considerations in Sanitation, Hygiene behaviour and cultural barriers, Gender issues in sanitation access.	10
5.	**Emerging Trends and Future Perspectives:** Innovations in Water Supply and Treatment, Smart water management (IoT, AI, remote sensing), Membrane filtration and desalination advancements. Innovations in Sanitation and Wastewater Reuse, Decentralized wastewater treatment systems.	7

COURSE OUTCOMES	
CO 1.	Importance of water supply and sanitation in public health and environmental sustainability.
CO 2.	Evaluate Sanitation Systems and Wastewater Management
CO 3.	Assess Environmental and Social Aspects of Water and Sanitation
CO 4.	Explore Emerging Trends and Future Perspectives like examine innovations in water supply, including smart water management (IoT, AI)
CO 5.	Importance of water supply and sanitation in public health and environmental sustainability.

TEXT BOOKS/REFERENCES	
S. No	**Book/Text Title**
1.	Water Supply Engineering – *S. K. Garg* (37th edition)
2.	Wastewater Engineering: Treatment and Resource Recovery – *Metcalf & Eddy* (Revised by George Tchobanoglous, Franklin L. Burton, H. David Stensel) (5th edition)
3.	Water Supply and Sanitary Engineering – *G.S. Birdie and J.S. Birdie* (9th edition)

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	4th
COURSE TITLE	Fluid Mechanics Applications in Engineering
COURSE CODE	CIV-258-E
COURSE CATEGORY	Professional Elective Course (PEC)
ELECTIVE TRACK	Hydrology and Water Resource Engineering

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
3	2	1	0	0	45

COURSE OBJECTIVES	
1.	Understand the basic principles of fluid mechanics and their applications in engineering.
2.	To analyze fluid behavior in various engineering systems, including pipelines, pumps, and open channels.
3.	To develop problem-solving skills related to real-world fluid mechanics applications.
4.	To introduce fundamental design considerations for hydraulic structures, fluid machinery, and transportation systems.
5.	To explore civil engineering applications of fluid mechanics in infrastructure, water resource management, and environmental engineering.

COURSE CONTENT		
Units	**Topic**	**Cont. Hours**
1.	**Fundamentals of Fluid Mechanics:** Introduction to Fluids and Properties, Definition of fluids, difference between liquids and gases. Properties of fluids: Density, viscosity, surface tension, compressibility, Basic fluid statics. Pressure variation, Pascal's law, hydrostatic forces. Fluid Dynamics Basics, Types of flow: Laminar vs. turbulent, steady vs. unsteady	12
2.	**2. Flow Through Pipes and Ducts:** Flow in Pipes, Continuity equation and mass conservation Energy losses in pipes: Major and minor losses Darcy-Weisbach equation, friction factor, Moody diagram Pipe Networks and Applications, Series and parallel pipe systems, Water distribution networks, Design considerations for pipelines	8
3.	**Open Channel Flow and Applications in Aerodynamics:** Introduction to Open Channel Flow, Differences between pipe flow and open channel flow. Types of flow in open channels: Uniform, varied, critical flow. Basics of Aerodynamics, Drag and lift forces, Application in vehicle design and wind tunnels (introduction only)	8

4.	**Civil Engineering Applications of Fluid Mechanics:** Flow measurement devices: Weirs, flumes	10
	Hydraulic structures: Dams, spillways, culverts, Fluid Flow in Transportation Systems Water and wastewater conveyance Fluid mechanics in road drainage systems.	
5.	**Environmental Engineering Applications of Fluid Mechanics:** Water Supply and Distribution Systems, Design of urban water supply networks, Pressure and flow control in distribution systems. Storm water and Wastewater Management, Drainage systems and flood management, Sewer hydraulics and wastewater collection. River Engineering and Coastal Hydraulics, Sediment transport and erosion control, River training works and coastal protection structures.	7

COURSE OUTCOMES	
CO 1.	Understand Fundamental Fluid Properties and Principles
CO 2.	Analyze Fluid Flow in Pipes and Ducts
CO 3.	Integrate Fluid Mechanics in Environmental Engineering Applications
CO 4.	Examine Open Channel Flow and Aerodynamic Applications
CO 5.	Apply Fluid Mechanics to Civil Engineering Structures and Systems

TEXT BOOKS/REFERENCES	
S. No	**Book/Text Title**
1.	Fluid Mechanics (8th Edition) – *Frank M. White*
2.	Fluid Mechanics and Hydraulic Machines (10th Edition) – *R. K. Bansal*
3.	Hydraulics and Fluid Mechanics Including Hydraulic Machines (22nd Edition) – *P. N. Modi & S. M. Seth*
4.	Fluid Mechanics with Engineering Applications (10th Edition) – *E. John Finnemore, Joseph B. Franzini*

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	5th
COURSE TITLE	**Groundwater Engineering**
COURSE CODE	CIV-309-E
COURSE CATEGORY	Professional Elective Course (PEC)
ELECTIVE TRACK	Hydrology and Water Resource Engineering

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
3	2	1	0	0	45

COURSE OBJECTIVES	
1.	Understand the fundamentals of groundwater hydrology, including occurrence, distribution, and movement.
2.	Analyze aquifer properties and well hydraulics for water resource management.
3.	Apply groundwater exploration techniques for site selection and development.
4.	Evaluate groundwater quality and contamination sources to design remediation strategies.
5.	Implement sustainable groundwater management practices using modern tools and models.

COURSE CONTENT		
Units	**Topic**	**Cont. Hours**
1.	**Fundamentals of Groundwater Hydrology:** • Introduction to groundwater and its significance • Hydrologic cycle and groundwater occurrence • Types of aquifers: Confined, unconfined, and perched aquifers • Groundwater movement and Darcy's Law • Hydraulic conductivity, transmissivity, and storativity • Groundwater flow equations and flow nets.	12
2.	**Well Hydraulics and Aquifer Testing:** • Types of wells: Dug, driven, and drilled wells • Well construction methods and materials • Steady and unsteady flow to wells in confined and unconfined aquifers • Theis, Jacob, and Cooper-Jacob methods • Pumping tests: Drawdown, recovery, and step-drawdown tests • Well efficiency and specific capacity calculations	8

3.	**Groundwater Exploration and Development:** • Remote sensing and geophysical techniques in groundwater exploration • Site selection criteria for wells and boreholes	8
	• Drilling techniques: Rotary, percussion, and auger methods • Well design, development, and maintenance • Artificial recharge of groundwater and managed aquifer recharge (MAR)	
4.	**Groundwater Quality and Contamination:** • Groundwater chemistry and quality parameters • Natural and anthropogenic sources of contamination • Saltwater intrusion and groundwater salinity • Nitrate, heavy metal, and microbial contamination • Groundwater remediation techniques: Pump-and-treat, bioremediation, and permeable reactive barriers • National and international groundwater quality standards	10
5.	**Groundwater Management and Modelling:** • Sustainable groundwater development and management strategies • Groundwater balance and safe yield concepts; Overdraft problems and land subsidence; Groundwater modelling: MODFLOW and analytical models • Conjunctive use of surface water and groundwater • Legal and policy frameworks for groundwater governance.	7

COURSE OUTCOMES	
CO 1.	Understand the Fundamentals of Groundwater Hydrology
CO 2.	Analyze Well Hydraulics and Aquifer Testing
CO 3.	Explore Groundwater Resources and Development Techniques
CO 4.	Assess Groundwater Quality and Contamination Issues
CO 5.	Apply Groundwater Management and Modelling Strategies

TEXT BOOKS/REFERENCES	
S. No	**Book/Text Title**
1.	Groundwater Hydrology – David Keith Todd & Larry W. Mays (3rd Edition, 2004)
2.	Groundwater Science – Charles R. Fitts (2nd Edition, 2012)
3.	Handbook of Groundwater Engineering – Jacques W. Delleur (2nd Edition, 2006)

PROGRAMME	B.Tech. Civil Engineering (Regular)				
SEMESTER	6th				
COURSE TITLE	Rural & Urban Sanitation				
COURSE CODE	CIV-359-E				
COURSE CATEGORY	Professional Elective Course (PEC)				
ELECTIVE TRACK	Hydrology and Water Resource Engineering				
CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
3	2	1	0	0	45

COURSE OBJECTIVES	
1.	Understand the principles of sanitation and its impact on public health.
2.	Differentiate between rural and urban sanitation systems and challenges.
3.	Analyze various sanitation technologies for wastewater and solid waste management.
4.	Assess the role of hygiene promotion and behavioural change in improving sanitation.
5.	Evaluate sanitation policies, programs, and sustainable sanitation solutions.

COURSE CONTENT		
Units	**Topic**	**Cont. Hours**
1.	**Introduction to Sanitation and Public Health:** Definition and importance of sanitation; Link between sanitation and public health; Historical perspective on sanitation improvements Sanitation coverage: Global and national perspectives Key Sustainable Development Goals (SDGs) related to sanitation.	09
2.	**Rural Sanitation:** Characteristics and challenges of rural sanitation; Open defecation and its impacts Low-cost sanitation technologies for rural areas like Pit latrines, ventilated improved pit (VIP) latrines, & Twin-pit latrines, composting toilets, biodigesters Community-Led Total Sanitation (CLTS) approach Rural wastewater and greywater management Solid waste management in rural areas.	09
3.	**Urban Sanitation:** Characteristics and challenges of urban sanitation On-site sanitation systems: Septic tanks, soak pits, biogas digesters Off-site sanitation systems: Sewerage systems, decentralized wastewater treatment systems (DEWATS) Faecal sludge and septage management (FSM) Drainage and storm water management; Urban solid waste management and landfill operations.	09

4.	**Hygiene Promotion and Behavioral Change:** Importance of hygiene in sanitation; Handwashing and personal hygiene practices Hygiene education and awareness campaigns School and community sanitation programs Role of gender and social inclusion in sanitation programs Behavioral change models and case studies	09
5.	**Sanitation Policies, Sustainability, and Innovations:** National and international sanitation policies (Swachh Bharat Mission, WHO, UNICEF, etc.) Sustainable sanitation approaches: Eco-sanitation, circular sanitation economy. Emerging technologies in sanitation: Smart toilets, IoT-based sanitation monitoring. Financing and governance of sanitation programs.	09

COURSE OUTCOMES	
CO 1.	Understand the Fundamentals of Sanitation and Public Health
CO 2.	Evaluate Rural Sanitation Challenges and Solutions
CO 3.	Analyze Urban Sanitation Systems
CO 4.	Promote Hygiene and Behavioral Change in Sanitation
CO 5.	Examine Sanitation Policies, Sustainability, and Innovations

TEXT BOOKS/REFERENCES	
S. No	**Book/Text Title**
1.	**"Environmental Sanitation and Waste Management"** – Alok Sikka, Asit K. Biswas, Cecilia Tortajada (1st Edition, 2020)
2.	**"Environmental Engineering: Water, Wastewater, Soil and Groundwater Treatment and Remediation"** – Nelson L. Nemerow (7th Edition, 2022)
3.	**"Sanitation and Sustainable Development in Developing Countries"** – Jan-Olof Drangert, Hans-Joachim Mosler(1st Edition, 2023)

PROGRAMME	B.Tech. Civil Engineering (Regular)				
SEMESTER	7th				
COURSE TITLE	Hydropower Engineering				
COURSE CODE	CIV-408-E				
COURSE CATEGORY	Professional Elective Course (PEC)				
ELECTIVE TRACK	Hydrology and Water Resource Engineering				
CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
3	2	1	0	0	45

COURSE OBJECTIVES	
1.	To gain insight into the basic concepts of hydropower engineering
2.	To provide insight into the design of various components of hydropower structures such as Dams, penstock, tunnels, surge tanks, draft tubes etc.
3.	To study the selection of suitable turbines for various types of hydropower plants.

COURSE CONTENT		
Units	**Topic**	**Cont. Hours**
1.	**INTRODUCTION:** Sources and forms of energy, types of power plants and their comparison, elements of hydropower scheme, hydropower development in India, Hydropower plants classification based on head, storage capacity and layout. Estimation of Hydropower potential, Processing of hydrological data, Use of extreme and long term hydrological data, mass and elevation volume curves, flow duration curves. Load and power studies: firm power, secondary power, load curve, load factor, load duration curve, firm capacity, reservoir capacity, capacity factors, Diversity Factor.	7
2.	**WATER CONVEYANCE SYSTEM:** Power canals: Alignment, Surges in Canals, Design of power canals. Penstocks: Alignment, types of penstocks, Economic diameter of penstocks, Anchor blocks, Water Hammer, Resonance. Behavior of surge tanks, types of surge tanks, hydraulic design, design of simple surge tank stability.	7
3.	**DAMS:** Selection of site, preliminary investigations, Final investigations. Types of Dams, Basic principles of design & details of construction of Gravity Dams. Earthen dams, rock-fill dams and their basic design Considerations. Spillways: Types of spillways, Spillway gates, Design of stilling basins.	6
4.	**HYDRAULIC TURBINES:** Types of turbines and their performance characteristics, Selection of turbines and their specific speed, Turbine setting, Scale ratio, Comparison of turbines, Governing of hydraulic turbines.	6
5.	**POWER HOUSE DETAILS:** General layout of power house & arrangement of hydropower units, Underground power stations.	4

COURSE OUTCOMES	
CO 1.	To understand the role of hydropower in the energy system, in India and internationally.
CO 2.	To describe the different concepts relevant to hydropower engineering.
CO 3.	To design essential elements of hydropower plant like conveyance structures, Impoundment structures and Powerhouse.
CO 4.	To select appropriate Turbine units for a hydropower setting.
CO 5.	To understand the role of hydropower in the energy system, in India and internationally.

TEXT BOOKS/REFERENCES		
S. No	**Book/Text Title**	**Author**
1.	Water Power Engineering	Dandekar, M.M.
2.	Water Power engineering	Deshmukh, M.M. Danpat Rai & Sons, New Delhi
3.	Power Plant Engineering	Nag P.K., Tata McGraw Hill, 2nd Edition, 4th reprint 2003.
4.	Power Plant Engineering	Dr.Sharma P.C, Kataria S. K. & Sons, 2009
5.	An introduction to power plant technology	Rai-Khanna. G.D., Publishers, Delhi, 2013

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	8th
COURSE TITLE	**Industrial Waste Water Treatment**
COURSE CODE	CIV-454-E
COURSE CATEGORY	Professional Elective Course (PEC)
ELECTIVE TRACK	Hydrology and Water Resource Engineering

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
3	2	1	0	0	45

COURSE OBJECTIVES	
1.	Understand the sources and characteristics of industrial wastewater from various industries
2.	Analyze physical, chemical, and biological treatment processes for wastewater treatment
3.	Design primary, secondary, and tertiary treatment systems for industrial effluents
4.	Explore advanced treatment technologies for removal of emerging contaminants
5.	Evaluate wastewater reuse, sludge management, and regulatory frameworks

COURSE CONTENT		
Units	**Topic**	**Cont. Hours**
1.	**Industrial Wastewater Characteristics and Regulations:** Introduction to industrial wastewater and its environmental impacts Sources and characteristics of industrial wastewater (textile, food, pharmaceuticals, pulp & paper, tannery, chemical industries, etc.) Physicochemical parameters: pH, COD, BOD, TDS, heavy metals, emerging contaminants. Regulatory standards and environmental laws (CPCB, EPA, WHO guidelines). Industrial wastewater monitoring and compliance.	7
2.	**Primary Treatment of Industrial Wastewater:** Screening and grit removal. Sedimentation and flotation processes. Equalization and flow regulation. Coagulation and flocculation. Neutralization and pH adjustment.	7
3.	**Secondary (Biological) Treatment Processes:** Introduction to biological treatment methods. Aerobic treatment processes: Activated sludge process (ASP), trickling filters, oxidation ponds. Anaerobic treatment processes: UASB reactors, anaerobic digesters, fluidized bed reactors Factors affecting biological treatment efficiency Sludge production and handling.	6

4.	**Advanced Treatment and Resource Recovery:** Tertiary treatment methods: Filtration, adsorption, membrane processes (RO, UF, NF). Advanced oxidation processes (AOPs):	6
	Ozonation, Fenton's reaction, photocatalysis. Removal of nutrients (nitrogen and phosphorus). Heavy metal and emerging contaminant removal. Industrial wastewater reuse and zero liquid discharge (ZLD) concepts.	
5.	**Industrial Wastewater Management and Case Studies:** Sustainable industrial wastewater treatment approaches. Cost-effective treatment solutions for small and large-scale industries. Sludge treatment and disposal methods: Dewatering, composting, incineration Energy recovery from industrial wastewater (biogas, bioelectricity) Case studies: Successful industrial wastewater treatment plants (pharmaceuticals, textiles, breweries, etc.); Future trends in industrial wastewater treatment.	4

COURSE OUTCOMES	
CO 1.	Understand Industrial Wastewater Characteristics and Regulations
CO 2.	Apply Primary Treatment Techniques like creening, grit removal, sedimentation, flow equalization and coagulation-flocculation
CO 3.	Evaluate Secondary (Biological) Treatment Processes like aerobic and anaerobic biological treatment methods
CO 4.	Develop Sustainable Industrial Wastewater Management Strategies

TEXT BOOKS/REFERENCES	
S. No	**Book/Text Title**
1.	**"Wastewater Engineering: Treatment and Resource Recovery"** – Metcalf & Eddy (Revised by George Tchobanoglous, Franklin L. Burton, H. David Stensel) **(5th Edition, 2014)**
2.	**"Industrial Water Quality"** – Ellen E. Goyer and William Wesley Eckenfelder Jr. (4th Edition, 2020)
3.	**"Industrial Wastewater Treatment"** – Patricia L. Keen and Eric H. Hart (2nd Edition, 2016)

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	3rd
COURSE TITLE	**Introduction to Pavement Material**
COURSE CODE	CIV-210-E
COURSE CATEGORY	Professional Elective Course (PEC)
ELECTIVE TRACK	Transportation Engineering

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
3	2	1	0	0	45

COURSE OBJECTIVES	
1.	To introduce the basic concepts and importance of pavement materials in road construction.
2.	To understand the properties, classification, and testing of soils used in pavements.
3.	To study the characteristics, tests, and role of aggregates in pavement performance.
4.	To learn about types, properties, and testing of bituminous materials used in pavements.
5.	To explore advanced, eco-friendly, and sustainable pavement materials and their applications.

COURSE CONTENT		
Units	**Topic**	**Cont. Hours**
1.	**Introduction to Pavement Materials.** Overview of pavement materials; types of pavements - flexible and rigid; functions of pavement layers; requirements and desirable properties of pavement materials; material selection criteria.	9
2.	**Soil as a Pavement Material.** Types of soils used in pavements; engineering and index properties of soil; soil classification systems; standard laboratory tests - Proctor, CBR, Atterberg limits; soil stabilization techniques.	8
3.	**Aggregates for Pavement Construction.** Sources and types of aggregates; properties - strength, shape, gradation; tests - impact, abrasion, crushing, soundness, flakiness; use of recycled aggregates; influence on pavement performance.	10

4.	**Bituminous Materials.** Types of bituminous binders; properties and specifications; grading systems; standard tests - penetration, ductility, softening point, viscosity; bituminous mix design basics; modified binders.	9
5.	**Advanced and Sustainable Pavement Materials.** Innovative materials - Geosynthetics, polymers, fibers; recycling and use of waste materials; sustainability and environmental considerations in material selection; recent case studies.	9

COURSE OUTCOMES	
CO 1.	Explain the significance of pavement materials in construction and performance.
CO 2.	Analyze soil properties, classifications, and interpret test results for pavement applications.
CO 3.	Assess aggregate properties and perform standard tests related to pavement performance.
CO 4.	Evaluate bituminous materials based on types, properties, and standard testing procedures.
CO 5.	Apply knowledge of modern and sustainable materials in pavement design and construction.

TEXT BOOKS/REFERENCES	
S. No	**Book/Text Title**
1.	Khanna, S. K., Justo, C. E. G., & Veeraragavan, A. (2019). Highway Engineering. Nem Chand & Bros.
2.	Sharma, S. K. (2017). Principles, Practice and Design of Highway Engineering. S. Chand Publishing.
3.	Vinson, T. S. (1996). Pavement materials for environmental conditions. CRC Press.
4.	Huang, Y. H. (2004). Pavement Analysis and Design (2nd ed.). Pearson Prentice Hall.
5.	National Highway Institute. (2006). Pavement Material Characterization. Federal Highway Administration, USA.

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	4th
COURSE TITLE	Road Safety and Management
COURSE CODE	CIV-259-E
COURSE CATEGORY	Professional Elective Course (PEC)
ELECTIVE TRACK	Transportation Engineering

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
3	2	1	0	0	45

COURSE OBJECTIVES	
1.	Understand the fundamentals of road safety and accident analysis.
2.	Analyze human, vehicle, and road factors contributing to accidents.
3.	Learn road safety measures, traffic management techniques, and regulations.
4.	Explore modern road safety audits and management practices.
5.	Evaluate road safety improvement strategies and implement case studies.

COURSE CONTENT		
Units	**Topic**	**Cont. Hours**
1.	**Introduction to Road Safety:** Importance, scope, accident statistics, global and Indian road safety scenario, accident investigation and analysis basics.	9
2.	**Accident Causative Factors:** Human factors, vehicle design factors, road infrastructure, environmental factors, and their impact on accident causation.	10
3.	**Traffic Management & Road Safety Measures:** Speed management, traffic calming, pedestrian and cyclist safety, traffic signs, road markings, and road furniture.	8
4.	**Road Safety Audits and Management:** Safety audits process, black spot identification, risk assessment, institutional arrangements, and stakeholder roles.	10
5.	**Road Safety Improvement Strategies and Case Studies:** Engineering, education, enforcement, emergency care strategies, case studies on road safety improvements.	8

COURSE OUTCOMES	
CO 1.	Explain the importance of road safety and basic accident analysis methods.
CO 2.	Identify various accident causative factors and conduct basic analysis.
CO 3.	Apply traffic management techniques and road safety measures.

CO 4.	Perform road safety audits and propose management strategies.
CO 5.	Recommend suitable improvement strategies based on case studies.

TEXT BOOKS/REFERENCES	
S. No	**Book/Text Title**
1.	Khanna, S. K., & Justo, C. E. G. (2017). Highway Engineering. Nem Chand & Bros.
2.	Kadiyali, L. R. (2013). Traffic Engineering and Transport Planning. Khanna Publishers.
3.	MoRTH - Road Safety Manual (Government of India Publication)
4.	IRC Guidelines on Road Safety and Traffic Management

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	5th
COURSE TITLE	**Sustainable Transportation Infrastructure**
COURSE CODE	CIV-310-E
COURSE CATEGORY	Professional Elective Course (PEC)
ELECTIVE TRACK	Transportation Engineering

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
3	2	1	0	0	45

COURSE OBJECTIVES	
1.	Understand the fundamental principles of sustainable transportation systems.
2.	Evaluate various green and eco-friendly transportation modes and technologies.
3.	Analyze policies and planning methods for sustainable transportation infrastructure.
4.	Explore the role of renewable energy and intelligent transport systems (ITS) in transportation.
5.	Assess the environmental and economic impacts of sustainable transportation solutions.

COURSE CONTENT		
Units	**Topic**	**Cont. Hours**
1.	**Introduction to Sustainable Transportation:** Concept and definition of Sustainable Transportation Importance of sustainability in transportation Global environmental issues related to transport Principles of sustainable transportation systems Sustainable Development Goals (SDGs) and their relevance to transportation	10
2.	**Green Transportation Modes and Technologies:** Overview of public transport systems – Metro, Bus Rapid Transit (BRT) Non-Motorized Transport (NMT) – Cycling, Walking infrastructure Introduction to Electric Vehicles (EVs) and Hybrid Vehicles Low-emission vehicles and fuel-efficient technologies Sustainable logistics and freight transportation systems	9

3.	**Sustainable Transportation Planning and Policy:** Principles of land-use and transportation integration Transport policies promoting sustainability Regulatory frameworks and environmental standards Public participation and community engagement in planning	8
	Funding mechanisms and government initiatives for sustainable transport	
4.	**Renewable Energy and Intelligent Transport Systems (ITS):** Role of renewable energy in transportation sector ITS applications in traffic management and public transport Smart transportation networks and future trends Energy efficiency measures and green infrastructure Data-driven approaches and technology innovations	10
5.	**Environmental and Economic Impacts of Sustainable Transport:** Assessing environmental impacts – Air pollution, Noise, Carbon footprint Life Cycle Assessment (LCA) of transportation projects Cost-benefit analysis of sustainable transport solutions Global case studies on successful sustainable transportation projects Challenges and future prospects in sustainable transportation	8

COURSE OUTCOMES	
CO 1.	Explain the basic concepts and need for sustainable transportation systems.
CO 2.	Compare different sustainable transportation modes and their applications.
CO 3.	Formulate sustainable transportation plans integrating modern policies and strategies.
CO 4.	Interpret the significance of renewable energy and ITS in sustainable transport.
CO 5.	Evaluate sustainable transportation solutions in terms of their environmental and economic impacts.

TEXT BOOKS/REFERENCES	
S. No	**Book/Text Title**
1.	Sinha, K.C., & Labi, S. (2007). Transportation Decision Making: Principles of Project Evaluation and Programming. Wiley.
2.	Black, W.R. (2010). Sustainable Transportation: Problems and Solutions. Guilford Press.
3.	Litman, T. (2021). Transportation and Environmental Policy. Victoria Transport Policy Institute.
4.	World Bank Group. (2018). Sustainable Transport: A Sourcebook for Policy-makers in Developing Cities.
5.	OECD. (2015). Green Growth and Transport. OECD Publishing.

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	6th
COURSE TITLE	Transport Innovations and Industrial Progress
COURSE CODE	CIV-360-E
COURSE CATEGORY	Professional Elective Course (PEC)
ELECTIVE TRACK	Transportation Engineering

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
3	2	1	0	0	45

COURSE OBJECTIVES	
1.	Understand the evolution and significance of transport systems in industrial development.
2.	Analyze various modern transportation innovations and their industrial applications.
3.	Explore the economic impact of transportation advancements on industrial growth.
4.	Evaluate environmental and societal aspects of transport innovations.
5.	Identify future trends and challenges in transportation and industrial progress.

COURSE CONTENT		
Units	**Topic**	**Cont. Hours**
1.	**Historical Evolution of Transport Systems:** Introduction to the evolution of transport systems. Role of early transportation in industrial revolutions. Development of maritime, rail, and road transport. Case studies of industrial growth enabled by transportation.	9
2.	**Modern Transport Innovations:** Introduction to modern transport systems: High-speed rail, electric vehicles, hyper loop. Industrial applications of cutting-edge transport technologies. Role of AI, IoT, and automation in transportation. Case studies on innovative transport-driven industries.	7
3.	**Economic Impact of Transportation on Industrial Progress:** Transportation infrastructure and economic growth. Trade expansion and global industrial connectivity. Public and private investments in transportation. Case studies highlighting economic transformations via transportation.	7

4.	**Environmental and Societal Aspects of Transportation:** Environmental challenges and sustainable transport solutions. Impact on urbanization, employment, and society. Green transportation technologies and policies. Global and regional case studies on environmental impacts.	3
5.	**Future Trends and Challenges in Transport and Industry:** Emerging technologies: Autonomous vehicles, drones, space transport. Industrial adaptations to futuristic transportation. Policy and regulatory challenges. Future case scenarios and industrial opportunities.	4

COURSE OUTCOMES	
CO 1.	Demonstrate understanding of historical transport systems and their industrial impact.
CO 2.	Apply knowledge of modern transport innovations in industrial contexts.
CO 3.	Assess the economic contributions of transportation to industrial progress.
CO 4.	Analyze the environmental and social implications of transportation systems.
CO 5.	Predict future transportation trends and propose innovative industrial solutions.

TEXT BOOKS/REFERENCES	
S. No	**Book/Text Title**
1.	Rodrigue, J. P. (2020). The Geography of Transport Systems. Routledge.
2.	Gwilliam, K. (2003). Transport infrastructure and economic development. World Bank.
3.	Button, K. (2010). Transport Economics. Edward Elgar Publishing.
4.	Coyle, J. J., et al. (2017). Transportation: A Supply Chain Perspective. Cengage Learning.
5.	Banister, D. (2002). Transport Planning. Taylor & Francis.

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	7th
COURSE TITLE	Transportation Planning And Economics
COURSE CODE	CIV-409-E
COURSE CATEGORY	Professional Elective Course (PEC)
ELECTIVE TRACK	Transportation Engineering

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
3	2	1	0	0	45

COURSE OBJECTIVES	
1.	To familiarize students with the key factors that affect vehicle dynamics and their implications on road design.
2.	To enable students to apply principles of physics and engineering to compute critical sight distance requirements for safe driving.
3.	To introduce students to fundamental traffic flow concepts and modelling techniques used in transportation engineering.
4.	To equip students with the skills to Analyze and assess traffic performance using level of service criteria.
5.	To train students in the application of Highway Capacity Software for evaluating and improving roadway performance.

COURSE CONTENT		
Units	**Topic**	**Cont. Hours**
1.	**Introduction:** Scope of transportation planning and transportation economics, transportation planning issues.	7
2.	**Public Transportation:** public transport modes, desirable characteristics of public transport systems, transit system operations, route development, stopping policy, stop location, scheduling, the capacity of transit systems, socially optimal pricing.	9
3.	**Transport analysis and forecasting:** Transport planning process, transportation and land use, transport planning strategies, transport planning models, travel demand analysis, operational transportation, and land use, models.	10

4.	**Transport economics and finance:** Pavement economics- construction cost; maintenance cost and vehicle operation cost, economic evaluation of highway projects- basic principles.	9
5.	**Transportation Economics:** Time value of money; costs and benefits; net present value (NPV) method; benefit cost (B/C) ratio method; internal rate of return (IRR) method; comparison of evaluation techniques, freight transport-trends, and economic growth.	10

COURSE OUTCOMES	
CO 1.	Understand the factors influencing road vehicle performance characteristics and design.
CO 2.	Apply basic science principles in estimating stopping and passing sight distance requirements.
CO 3.	Understand basic traffic stream parameters and models, traffic flow models, and queuing theory.
CO 4.	Perform level of service analysis to determine LOS for selected highway segments.
CO 5.	Use Highway Capacity Software (HCS) for finding LOS.

TEXT BOOKS/REFERENCES		
S. No	**Book/Text Title**	**Author**
1.	Transport Planning and Traffic Engineering	CA O'Flaherty, John Wiley & Sons, Inc., New York; Toronto.
2.	Transportation Engineering and Planning	Papacostas&Prevedouros, Prentice-Hall of India Private Ltd, New Delhi-110001
3.	Principles of Transportation Engineering	Chakarborty& Das, Prentice-Hall of India Private Ltd, New Delhi-110001
4.	Urban Transportation Planning	Meyer & Miller, McGraw Hill, New Delhi
5.	Transport Planning and Traffic Engineering	CA O'Flaherty, John Wiley & Sons, Inc., New York; Toronto.

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	8th
COURSE TITLE	Design and Maintenance of Roads
COURSE CODE	CIV-455-E
COURSE CATEGORY	Professional Elective Course (PEC)
ELECTIVE TRACK	Transportation Engineering

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
3	2	1	0	0	45

COURSE OBJECTIVES	
1.	Understand the fundamentals of pavement deterioration and maintenance concepts.
2.	Identify different types of pavement distress and evaluation methods.
3.	Analyze rehabilitation techniques and materials used in pavement restoration.
4.	Learn about pavement performance evaluation and life cycle cost analysis.
5.	Develop skills to plan and design maintenance strategies for pavements.

COURSE CONTENT		
Units	**Topic**	**Cont. Hours**
1.	**Introduction to Pavement Maintenance and Rehabilitation:** Overview of pavement types and structures. Need for maintenance and rehabilitation. Factors affecting pavement performance and deterioration. Maintenance strategies: preventive, corrective, and emergency maintenance.	7
2.	**Pavement Distresses and Evaluation Methods** Types of pavement distresses: cracking, rutting, potholes, surface wear. Visual inspection techniques. Non-destructive evaluation methods: FWD, GPR, deflection measurements. Structural and functional evaluation of pavements.	10
3.	**Maintenance Materials and Techniques:** Bituminous and concrete patching materials. Crack sealing and filling materials and techniques. Surface treatments: slurry seal, fog seal, chip seal, micro surfacing. Cold and hot recycling techniques.	8

4.	**Pavement Rehabilitation Techniques:** Overlay design methods and types. Milling and recycling processes. Strengthening techniques for flexible and rigid pavements. Rehabilitation of rural and urban pavements.	10
5.	**Performance Evaluation and Maintenance Planning:** Pavement Performance models and serviceability index. Life cycle cost analysis and budgeting for pavement maintenance. Prioritization of maintenance projects. Case studies of successful pavement maintenance and rehabilitation projects.	10

COURSE OUTCOMES	
CO 1.	Explain the causes of pavement deterioration and importance of maintenance.
CO 2.	Detect and evaluate various pavement distresses using standard procedures.
CO 3.	Choose appropriate rehabilitation techniques and materials for pavement repair.
CO 4.	Evaluate pavement performance and conduct life cycle cost analysis.
CO 5.	Formulate maintenance plans considering technical and economic aspects.

TEXT BOOKS/REFERENCES		
S. No	**Book/Text Title**	**Author**
1.	Principles of Pavement Design	Yoder, E.J. and Witczak, M.W.
2.	Pavement Analysis and Design	Huang, Y.H.
3.	Specifications for Road and Bridge Works	MORTH
4.	Highway Engineering	Khanna, S.K. and Justo, C.E.G.
5.	Principles, Practice and Design of Highway Engineering	Sharma, S.K.

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	3rd
COURSE TITLE	Soft Skills for Civil Engineers
COURSE CODE	CIV-211-E
COURSE CATEGORY	Professional Elective Course (PEC)
ELECTIVE TRACK	Skill Development in Civil Engineering

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
3	2	1	0	0	45

COURSE OBJECTIVES	
1.	Understand the importance of effective communication in the civil engineering profession.
2.	Develop interpersonal and teamwork skills essential for project-based environments.
3.	Enhance presentation and public speaking abilities with practical applications.
4.	Learn time management and stress-handling strategies for academic and workplace efficiency.
5.	Foster leadership qualities and ethical decision-making in professional settings.

COURSE CONTENT		
Units	**Topic**	**Cont. Hours**
1.	**Introduction to Communication Skills:** Verbal and non-verbal communication Listening skills Writing professional emails Communication in project teams Role-plays and case studies	12
2.	**Teamwork and Collaboration:** Team roles and dynamics Conflict resolution Working in interdisciplinary teams Group discussions and feedback techniques	8
3.	**Presentation and Public Speaking:** Designing presentations Using visual aids Handling Q&A sessions Speaking confidently in public	8

4.	**Time and Stress Management:** Prioritization techniques Work-life balance Coping with pressure Academic vs professional stress	10
5.	**Leadership and Professional Ethics**:	7
	Leadership theories and styles Responsibility and accountability Engineering ethics and codes Ethical dilemmas	

COURSE OUTCOMES	
CO 1.	Demonstrate effective communication techniques suited to civil engineering scenarios.
CO 2.	Collaborate efficiently in team-oriented tasks and civil engineering projects.
CO 3.	Deliver structured oral presentations and manage professional interactions.
CO 4.	Apply time and stress management techniques to balance academic and fieldwork.
CO 5.	Display leadership behaviour with ethical responsibility in engineering roles.

TEXT BOOKS/REFERENCES	
S. No	**Book/Text Title**
1.	Meenakshi Raman & Sangeeta Sharma, Technical Communication, Oxford University Press.
2.	Barun K. Mitra, Personality Development and Soft Skills, Oxford University Press.
3.	P. Subba Rao, Management and Organizational Behavior, Himalaya Publishing.
4.	Stephen Covey, The 7 Habits of Highly Effective People, Free Press.
5.	Carnegie Dale, How to Win Friends and Influence People, Simon & Schuster.

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	4th
COURSE TITLE	Entrepreneurship & Start-ups in Civil Engineering
COURSE CODE	CIV-260-E
COURSE CATEGORY	Professional Elective Course (PEC)
ELECTIVE TRACK	Skill Development in Engineering

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
3	2	1	0	0	45

COURSE OBJECTIVES	
1.	To introduce the fundamentals of entrepreneurship and its relevance in civil engineering.
2.	To develop business planning and managerial skills related to construction start-ups.
3.	To analyse market feasibility and funding mechanisms for civil engineering start-ups.
4.	To impart knowledge about legal, ethical, and regulatory frameworks in the start-up ecosystem.
5.	To promote innovation, sustainability, and problem-solving abilities for start-up success.

COURSE CONTENT		
Units	**Topic**	**Cont. Hours**
1.	**Entrepreneurship Fundamentals:** Definition, need and importance of entrepreneurship in civil engineering. Entrepreneurial mind set and characteristics of successful entrepreneurs. Types of entrepreneurship: social, tech-based, green and scalable start-ups. Civil engineering start-ups: Case studies and local relevance. Role of entrepreneurship in national development and infrastructure.	12
2.	**Business Planning and Idea Generation:** Identifying problems and converting them into business ideas. Feasibility study and SWOT analysis for civil engineering ventures. Business model canvas, value proposition design, and lean start-up principles. Drafting business plans: mission, vision, market research, team and operations.	8

3.	**Funding and Financial Aspects:** Sources of funding: angel investors, venture capital, government schemes. Basics of start-up financing, revenue models, budgeting, and cost estimation. Preparing financial projections and investor pitch. Understanding start-up incubators and accelerators in India.	8
4.	**Legal and Ethical Aspects:**	10
	Legal structure of start-ups: sole proprietorship, partnership, Pvt. Ltd. companies. IPR, patents, copyrights, and trademarks relevant to civil start-ups. Environmental and labour regulations applicable to construction start-ups. Ethics in business and corporate social responsibility (CSR).	
5.	**Innovation, Sustainability & Start-up Management:** Design thinking and innovation in construction technologies. Sustainable practices in civil engineering and start-up ecosystems. Project management basics for start-up success. Scaling strategies and exit planning for civil engineering start-ups.	7

COURSE OUTCOMES	
CO 1.	Understand the concept and importance of entrepreneurship in civil engineering.
CO 2.	Develop and present business plans for start-up ventures in construction and infrastructure.
CO 3.	Evaluate market opportunities and funding options for civil engineering start-ups.
CO 4.	Apply legal and ethical practices in establishing and running start-ups.
CO 5.	Demonstrate innovative thinking to solve real-world civil engineering problems through start-ups.

TEXT BOOKS/REFERENCES	
S. No	**Book/Text Title**
1.	Hisrich, R. D., Peters, M. P., & Shepherd, D. A. (2017). Entrepreneurship. McGraw-Hill Education.
2.	Timmons, J. A., & Spinelli, S. (2009). New Venture Creation: Entrepreneurship for the 21st Century. McGraw-Hill.
3.	Kuratko, D. F. (2016). Entrepreneurship: Theory, Process, and Practice. Cengage Learning.
4.	Innovation and Entrepreneurship Development, by SS Khanka, S. Chand Publishing.
5.	Start-up India Learning Program by Invest India: https://www.startupindia.gov.in

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	5th
COURSE TITLE	Integrated Waste Management for a Smart City
COURSE CODE	CIV-311-E
COURSE CATEGORY	Professional Elective Course (PEC)
ELECTIVE TRACK	Skill Development in Civil Engineering

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
3	2	1	0	0	45

COURSE OBJECTIVES	
1.	Understand the fundamentals of solid waste management including sources, characteristics, quantities, and current challenges in urban India.
2.	Familiarize with national regulatory frameworks including Solid Waste Management Rules 2016 and E-Waste Management Rules 2016, and understand institutional roles of CPCB, SPCB, and MoEF.
3.	Gain knowledge of municipal solid waste collection, transportation, segregation, processing, and scientific disposal methods including sanitary landfilling and energy recovery.
4.	Understand biological treatment technologies such as composting, biomethanation, and waste-to-energy systems for sustainable resource recovery.
5.	Develop awareness of special waste streams such as Construction & Demolition (C&D) waste and Electronic waste (E-waste), including their regulations, reuse potential, and management challenges.

COURSE CONTENT		
Units	**Topic**	**Cont. Hours**
1.	**Fundamentals of Solid Waste Management** Introduction to Solid Waste Management, Types and Sources of Solid Waste, Municipal Solid Waste (MSW) Characteristics and Quantities, Current Issues in Solid Waste Management, Overview of MSW Management in Selected Smart Cities	12
2.	**Chapter 2: Regulatory Framework and Policies** Municipal Solid Waste Management Rules, 2016, E-Waste Management Rules, 2016. Regulatory Roles of CPCB, SPCB, and MoEF	8
3.	**Collection, Processing and Disposal of MSW** Municipal Solid Waste Collection Systems, Transportation and Segregation Practices, Disposal Methods (Sanitary Landfilling), Energy Recovery from Municipal Solid Waste	7
4.	**Biological and Resource Recovery Processes** Biochemical Processes in Waste Treatment, Composting (Aerobic & Anaerobic Methods), Biomethanation, Waste-to-Energy Concepts, Circular Economy and Resource Recovery	9

5.	**Special Wastes Management** Construction and Demolition (C&D) Waste – Overview, C&D Waste Regulations and Beneficial Reuse, Electronic Waste (E-Waste): Issues and Status (India & Global Scenario), E-Waste Management Challenges	9

COURSE OUTCOMES	
CO 1.	Classify different types of solid waste and analyze MSW characteristics and quantities for urban planning applications.
CO 2.	Interpret and apply relevant provisions of Solid Waste Management Rules 2016 and E-Waste Management Rules 2016 in real-world scenarios.
CO 3.	Design and evaluate appropriate waste collection, transportation, segregation, and sanitary landfill systems.
CO 4.	Compare and select suitable biological and energy recovery technologies for sustainable waste management solutions.
CO 5.	Propose management strategies for C&D waste and E-waste based on regulatory requirements and environmental sustainability principles.

TEXT BOOKS/REFERENCES		
S. No	**Book/Text Title**	**Author**
1.	**Integrated Solid Waste Management**,	*George Tchobanoglous, Hilary Theisen & Samuel A. Vigil*, McGraw-Hill
2.	**Environmental Engineering Volume II**,	K.K. Arora, Standard Publishers
3.	**Environmental Engineering**,	H.S. Peavy & D.R. Row, McGraw-Hill

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	6th
COURSE TITLE	Programming for Engineers
COURSE CODE	CIV-361-E
COURSE CATEGORY	Professional Elective Course (PEC)
ELECTIVE TRACK	Skill Development in Civil Engineering

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
3	2	1	0	0	45

COURSE OBJECTIVES	
1.	To develop programming skills in Engineering students using two open-access data Analysis-oriented languages R and Python.
2.	Master the use of the R and R Studio for interactive environment.
3.	Understand the different data types in R.
4.	To study how to Read Structured Data into R from various sources.
5.	To be able to use Programming in Research projects at Graduate/Post Graduate level

COURSE CONTENT		
Units	**Topic**	**Cont. Hours**
1.	**Introduction:** Introduction to R Studio: Installing R Studio, overview, packages, getting Help	07
2.	**Data Types And Data Import:** Data Types: R Objects and attributes, vectors and lists, matrices; factors; data frames, dates and times; reading tabular data; Sub-setting and Operations. Some practical applications	11
3.	**Loops And Choices:** Control Structures - Introduction; choices and loops, Loop functions: lapply; mapply; tapply; Some examples	09
4.	**Creating Functions In "R":** Functional Programming: Introduction, coding standards; piping; Practical applications;Some packages for Civil Engineers	09

5.	**Python:** Introduction: installation Anaconda and overview, libraries, and getting help. Data types and structures: strings, scalars, vectors, matrices, lists, reading tabular data, Numpy and Pandas	09

COURSE OUTCOMES	
CO 1.	Learn the core tools for data science with R
CO 2.	Build your own functions in R
CO 3.	To learn how to get your data in and out of R
CO 4.	Learn the fundamentals of statistics and apply them in practice
CO 5.	Work with R's conditional statements, functions, and loops

TEXT BOOKS/REFERENCES		
S. No	**Book/Text Title**	**Author**
1.	R for Data Science: Import, Tidy, Transform, Visualize, and Model Data (1st Edition)	Hadley Wickham
2.	Advanced R (2nd Edition)	Hadley Wickham, Chapman & Hall
3.	Introduction to Computation and Programming Using Python (2nd Edition)	John V. Guttag

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	7th
COURSE TITLE	AI & Machine Learning in Civil Engineering
COURSE CODE	CIV-410-E
COURSE CATEGORY	Professional Elective Course (PEC)
ELECTIVE TRACK	Skill Development in Civil Engineering

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
3	2	1	0	0	45

COURSE OBJECTIVES	
1.	To introduce basic concepts of Artificial Intelligence and Machine Learning.
2.	To explore supervised learning techniques and applications in civil projects.
3.	To understand unsupervised learning and its role in infrastructure analytics.
4.	To apply ML algorithms for structural health monitoring and predictive modelling.
5.	To explore the integration of AI tools in planning, design, and construction.

COURSE CONTENT		
Units	**Topic**	**Cont. Hours**
1.	**Introduction to AI and ML:** Definitions, scope, applications in civil engineering. Difference between AI, ML, DL; importance of data-driven approaches. Case studies in AI applications across construction, traffic, geotech, and structures.	12
2.	**Supervised learning:** Linear regression, Decision trees, SVM. Data pre-processing and feature engineering in civil datasets. Application of supervised models in cost estimation, traffic modelling.	8
3.	**Unsupervised learning:** Clustering, PCA, and anomaly detection. Use in material classification, geospatial clustering, remote sensing. Pattern discovery in historical construction or disaster data.	8
4.	**Structural Health Monitoring by AI & ML:** ML for structural health monitoring, sensor data analysis. Predictive maintenance using time-series and classification models. Smart building systems and risk prediction models.	9

5.	**Introduction to civil project workflows:** AI tools in BIM, design automation, and project planning. Ethics in AI, data privacy in engineering, model interpretability. Emerging trends – reinforcement learning, GANs, and digital twins.	8

COURSE OUTCOMES	
CO 1.	Understand AI/ML fundamentals and their importance in civil engineering.
CO 2.	Apply supervised learning models to civil datasets (e.g., regression, classification).
CO 3.	Analyze civil engineering data using unsupervised techniques like clustering.
CO 4.	Utilize ML for real-time monitoring and predictive maintenance in structures.
CO 5.	Integrate AI-based decision-making tools into civil project workflows.

TEXT BOOKS/REFERENCES		
S. No	**Book/Text Title**	**Author**
1.	Artificial Intelligence: A Modern Approach	Stuart Russell & Peter Norvig
2.	Hands-On Machine Learning with Scikit-Learn and TensorFlow	Aurélien Géron
3.	Python Machine Learning	Sebastian Raschka
4.	Machine Learning for Civil and Environmental Engineers	Srinivasan Chandrasekaran
5.	AI in Civil Engineering: Applications and Case Studies	Edited by Varghese George

PROGRAMME	B.Tech. Civil Engineering (Regular)
SEMESTER	8th
COURSE TITLE	Contracts & Legal Aspects in Civil Engineering
COURSE CODE	CIV-456-E
COURSE CATEGORY	Professional Elective Course (PEC)
ELECTIVE TRACK	Skill Development in Civil Engineering

CREDITS AND CONTACT HOURS					
CREDITS	**L**	**T**	**P**	**S**	**TOTAL NO. OF CONTACT HOURS**
3	2	1	0	0	45

COURSE OBJECTIVES	
1.	Understand the fundamental concepts of contracts and legal frameworks in civil engineering.
2.	Gain knowledge about different types of contracts, tendering procedures, and bid documentation.
3.	Learn the legal obligations, liabilities, and dispute resolution mechanisms in construction.
4.	Explore the role of professional ethics and contract administration in engineering practice.
5.	Familiarize students with legal case studies relevant to infrastructure and public works.

COURSE CONTENT		
Units	**Topic**	**Cont. Hours**
1.	**Legal terms and components of contracts:** Definition and significance of contracts in civil engineering. Types of contracts – item rate, lump sum, cost-plus, turnkey, etc. Legal framework and basics of Indian Contract Act.	12
2.	**Contracts and tenders:** Tendering process, pre-qualification, bidding methods. Contract formation, bid evaluation, and awarding. Roles of employer, contractor, and engineer.	8
3.	**Liabilities and disputes:** Contractual obligations and liabilities. Delays, claims, liquidated damages, and penalties. Dispute resolution: arbitration, litigation, conciliation.	8
4.	**Ethics in contract execution:** Contract administration and documentation. Change orders, contract close-out, and project supervision. Ethical practices and responsibilities in engineering contracts.	7

5.	**Legalities in Projects:** Legal case studies and judgments related to civil works. Public-private partnership (PPP) legal issues. RTI, labour laws, and environment-related legal obligations.	5

COURSE OUTCOMES	
CO 1.	Explain fundamental legal terms and components of contracts in civil engineering.
CO 2.	Prepare, interpret, and evaluate contract documents and tender procedures.
CO 3.	Analyze legal liabilities and resolve disputes using standard mechanisms.
CO 4.	Apply professional ethics in contract execution and project supervision.
CO 5.	Discuss landmark legal cases and their implications in engineering decisions.

TEXT BOOKS/REFERENCES

S. No	Book/Text Title	Author
1.	Construction Contracts: Questions and Answers	David Chappell
2.	Construction Law Handbook	Chappell and Powell-Smith
3.	Legal Aspects of Architecture, Engineering and the Construction Process	Justin Sweet
4.	Contract and Legal Framework in Construction	S.V. Deodhar
5.	Handbook on Construction Contracts	Madhav N. Savant

*******END*******