

B. Tech. Engineering					
Course code: Course Title		Course Structure			Pre-Requisite
CE201: Introduction to Earth, Atmosphere, climate, and environmental sciences	L	T	P	NIL	
	3	1	0		

Course Objective: To familiarize the students with the concepts of the subject and its related applications in climate studies

S. No	Course Outcomes (CO)
CO1	To develop an understanding of the basic concepts of the Earth and the Atmosphere
CO2	To understand different atmospheric and geological phenomena and processes
CO3	To conceptualize how to use the theoretical knowledge of climate studies in long-term climate change analysis
CO4	Understand the basic principles and practices of environment and biodiversity safeguarding

S. No	Contents	Contact Hours
UNIT 1	Introduction to Earth Sciences- Earth's physical features, evolution of Earth, Earth's composition, petrology and mineralogy, structural geology, geophysics, natural hazards- volcanoes, earthquakes, tsunami, glaciers, landslides, geological division of India	6
UNIT 2	Physical Geology- Earth's internal structure, variation of pressure, temperature density, theory of isostasy, continental drift, plate tectonics, folds, faults, and unconformities, rock and water cycle	6
UNIT 3	Introduction to atmospheric sciences- Solar radiation, electromagnetic spectrum and radiation, phenomenon of scattering, refraction, absorptivity, particles of atmosphere, states of matter in the atmosphere, fundamentals of atmospheric modelling	6
UNIT 4	Climate studies- Advection and convection winds, associated wind patterns, cloud formation, thermal heat generation, evaporation and condensation, precipitation, extreme weather events, numerical weather prediction	6
UNIT 5	Introduction to environmental studies- Definition, scope, and importance, natural resources, renewable and non-renewable resources, Social issues and the environment, human population and environment	6
UNIT 6	Environmental management- Environmental pollution- air/ water/ noise/ soil/ thermal, solid waste management, disaster management	6

UNIT 7	Biodiversity studies and management- Ecosystem and ecology, energy flow, productivity, biodiversity and conservation, biogeography, value of biodiversity, ex-situ and in-situ conservation, hot spots of biodiversity, endemic species, threats to biodiversity	6
	Total	42

REFERENCES		
S.No.	Name of Books/Authors/Publishers	Year of Publication / Reprint
1	Lenton, T., “Earth System Sciences”, Oxford University Press, (ISBN 9780198718871, 019871887X) .	2000
2	Lianko, A. A., “Introduction to Earth Sciences”, Katha Pub., (ISBN 9789715740357, 9715740359).	2012
3	Earle, S., “Physical Geology”, BCcampus, BC Open Textbook Project, (ISBN: 9781774200285, 1774200287).	2005
4	Kenning, F., “Introduction to atmospheric Physics”, Callisto Reference, (ISBN: 9781641160094, 1641160098).	2008
5	C. Dorland, M. A. van Drunen, R. Lasage, “Climate Change in Developing Countries”, CABI Pub., (ISBN: 9781845930776, 1845930770).	2021
6	Basu, M., Xavier, S., Savarimuthu, SJ, X. (2017). Fundamentals of Environmental Studies. India: Cambridge University Press.	2017
7	Biodiversity: Monitoring, Management and Utilization. (2018). India: DAYA Publishing House.	2018
8	Ahrens, C. D., & Henson, R. (2018). Essentials of Meteorology. Cengage Learning	2018

B. Tech. Engineering			
Course code: Course Title	Course Structure		Pre-Requisite
	L	T	P
CE202: Smart city planning and intelligent transportation	3	1	0

Course Objective: To familiarize the students with the fundamental concepts of smart city planning, intelligent transportation, and its related applications in urban planning

S. No	Course Outcomes (CO)
CO1	To understand urban planning, Smart City concepts, and their city planning
CO2	To understand the parameters involved in smart city planning
CO3	To understand the basic concept of digital twins
CO4	To familiarize oneself with intelligent transportation systems
CO5	To be able to implement knowledge of geographical information systems in building modelling

S. No	Contents	Contact Hours
UNIT 1	Introduction to Smart City Planning- Definition and evolution of smart cities, key components and pillars of smart city planning, urbanisation trends and challenges, sustainable development goals and smart cities, stakeholder engagement and collaboration, urban governance and policy frameworks, successful smart city initiatives-case study, MOHUA Smart City Guidelines	8
UNIT 2	Smart City Infrastructure Design- Infrastructure planning, integrated infrastructure systems- energy, water, and telecommunications, green building practices and sustainable architecture, resilient urban design and climate adaptation strategies, public space design and urban mobility. Accessibility and inclusive design principles, data-driven decision making in urban development, financing smart city projects- public-private partnership	8
UNIT 3	Fundamentals of Digital Twins- Introduction to digital twins-definition and conceptual framework, historical development and evolution, types of digital twins- physical, virtual, hybrid, technologies enabling digital twins- IoT, AI, cloud computing, digital twins in urban planning and management, data integration and interoperability challenges, future trends and innovation in digital twin technology	8
UNIT 4	Intelligent transportation systems- Overview ITS, components of ITS- sensors, communication networks, control systems, traffic management and optimization techniques, smart mobility solutions-connected vehicle and autonomous transportation, real-time data analytics for traffic monitoring and prediction, vehicle and localization and navigation, multi-modal transportation planning, successful ITS deployments in urban environments, regulatory and policy consideration and ITS implementation	8

UNIT 5	Building Information Modelling and GeoBIM- Introduction to BIM, principles and methodologies, applications of BIM in architecture, engineering, and construction, GeoBIM-integrating GIS with BIM, 3D urban modelling and visualization techniques, collaborative workflows in interdisciplinary coordination, BIM for facility management, emerging trends and future direction	10
	Total	42

REFERENCES		
S. No.	Name of Books/Authors/Publishers	Year of Publication / Reprint
1	Kapovits, A., et al., “Designing, Developing, and Facilitating Smart Cities”, Springer International Publishing, (ISBN 9783319449241, 3319449249) .	2000
2	Zoughbi, S., “Planning and Designing Smart Cities in Developing Nations”, IGI Global, (ISBN: 9781668435106, 1668435101).	2012
3	Chaudhary, G., et al., “Digital Twin Technology”, CRC Press, (ISBN: 9781000455878, 1000455874).	2005
4	Tyagi, A.K., Sreenath, N., “Intelligent Transportation Systems: Theory and Practice”, Springer Nature, Singapore, (ISBN: 9789811976223, 9811976228).	2008
5	Ying, Y., Koeva, M. N., Kuffer, M., & Zevenbergen, J. A. (2020, August). Urban 3d modelling methods: A state-of-the-art review. In XXIVth ISPRS Congress 2020 (pp. 699-706). International Society for Photogrammetry and Remote Sensing (ISPRS).	2021
6	Schiavi, B., Havard, V., Beddiar, K., & Baudry, D. (2022). BIM data flow architecture with AR/VR technologies: Use cases in architecture, engineering, and construction. Automation in Construction, 134, 104054.	2017
7	Teicholz, P. (Ed.). (2013). BIM for facility managers. John Wiley & Sons.	2018
8	Patacas, J., Dawood, N., Vukovic, V., & Kassem, M. (2015). BIM for facilities management: Evaluating BIM standards in asset register creation and service life planning. Journal of Information Technology in Construction.	2018
9	MOHUA Smart City Guidelines, India.	2015

B. Tech. Civil Engineering			
Course code: Course Title	Course Structure		Pre-Requisite
CE203: Design of Structures - I	L	T	P
	3	0	2

Course Objective: To familiarize the students with the basics of the Design of RCC Structures.

S. No	Course Outcomes (CO)
CO1	Provide a coherent development to the students for the courses in the sector of Reinforced Concrete Design
CO2	Develop the foundations of many basic engineering concepts related to the design of structures
CO3	Analyze and Design RC beams for Flexure, Shear, and Torsion
CO4	Analyze and design RC Short & Long columns for different axial loadings, Compute Bond, Anchorage, and Development Length for Columns and Beams
CO5	Design of Foundation and Slab, and also develop the Concept of Load Transfer Mechanism in Slab and Foundations

S. No	Contents	Contact Hours
UNIT 1	Introduction to Designing Process and Design Materials: Structural Layout-Analysis-Designing-Detailing, Stress-Strain curves for concrete and steel, Grade of Steel, Grade of Concrete, and Materials Properties, Design Process & Philosophies, Function of concrete and steel in RC Structures, Under Reinforced, Balanced, and Over-Reinforced Section.	8
UNIT 2	Introduction to Different Methods: Working Stress Method and Ultimate Strength Method: Introduction and assumptions, Limit State Method – Limit state of collapse and serviceability.	8
UNIT 3	Design of beams: Function of beams, Types of Beams (Singly Reinforced Beam, Doubly Reinforced Beam, Flanged Beam), Calculation of Moment Carrying Capacity of Beam Section, Design (Flexure, Shear & Torsion) of Rectangular and Flanged beam, Singly Reinforced Section and Doubly Reinforced Section (with appropriate checks).	8

UNIT 4	Design of Columns: Function of Column, Types of Columns (Short Column & Long Column), Design of Axially Loaded Short Column, Design (Flexure & Shear) of Axially Loaded Column, Uni-Axially Loaded Column, Bi-Axially Loaded Column. Bond, Anchorage and Development Length: Bond Strength and Development Length, Provision for Development Length in Tension, Anchorage by Hooks, Development Length in Compression, Bar Cutoff and Bend Points in Beams, Bar Splices with the help of an example.	8
UNIT 5	Design of Slab and Foundations: Functions of Foundation, Types of Foundation, Design (Flexure and Shear) of Isolated Column Footing & Combined Footing. Slab Behaviour and Design: Describe the load transfer mechanism in Slab, Design of One-way slab and Two-way Slab for Flexure, Shear, Temperature, and Shrinkage Requirements.	10
	Total	42

REFERENCES

S. No.	Name of Books/Authors/Publishers	Year of Publication / Reprint
1	A. K . Jain; Design of Concrete Structures, NemChand Publications.	2001
2	Dr. B.C. Punmia, A.K. Jain; RCC Designs; Laxmi Publication	2006
3	N. Krishna Raju, Advanced Reinforced Concrete Design, CBS Publishers.	2016
4	Varghese A. V., Advanced Reinforced Concrete, Varghese, Prentice Hall of India.	2011
5	Reinforced Concrete Design - S Unnikrishnan Pillai and Devdas Menon.	2007
6	IS Codes (latest) : IS:456, IS:875 (all parts), IS:1893(P-1,2), IS:4326, IS:13920, IS: 3370 (P-1 to 4), SP:16, SP:34.	

B. Tech. Civil Engineering

Course code: Course Title	Course Structure			Pre-Requisite
CE204: Analysis of Structures - II	L	T	P	CE209: Analysis of Structures - I
	3	1	0	

Course Objective: To familiarize the students with the concepts of Analysis of Indeterminate Structures.

S. No	Course Outcomes (CO)
CO1	Analyse indeterminate beams and frames by the Method of Consistent Deformation, the Strain Energy Method, the Three Moment Equation Method, the slope deflection method, and the moment distribution method.
CO2	Analyse beams and frames by flexibility and stiffness matrix methods.
CO3	Analyse portal frames for lateral loads by the Portal and Cantilever Method.
CO4	Analyse two-hinged arches and stiffening girders.
CO5	Draw the ILD of Indeterminate structural elements.

S. No	Contents	Contact Hours
UNIT 1	Analysis of indeterminate structures such as fixed beams, continuous beams, and indeterminate frames by Method of Consistent Deformation, Strain Energy Method, and the Three-Moment Equation Method	8
UNIT 2	Analysis of continuous beams , frames with and without translation of joints using the Slope Deflection Method and the Moment Area Method	8
UNIT 3	Analysis of beams , rigid and pin jointed frames by Flexibility (Force Method) & Stiffness (Displacement Method) Matrix Method	8
UNIT 4	Approximate Analysis of Rectangular Building Frames by Portal Method and Cantilever Method	8

UNIT 5	Analysis of two-hinged Arches, basics of stiffening bridges with two and, three-hinged stiffening girders. Influence Lines of indeterminate beams, plane frames.	10
	Total	42

REFERENCES		
S. No.	Name of Books/Authors/Publishers	Year of Publication / Reprint
1	Theory of Structures (SMTS II), B. C. Punmia, A. K. Jain, A. K. Jain, Laxmi Publications Pvt. Ltd.	2004
2	Structural Analysis: A Matrix Approach, G. Pandit and S. Gupta, McGraw-Hill Education.	2008
3	Structural Analysis, R.C. Hibbeler, Prentice Hall.	2012
4	Structural Analysis, Aslam Kassimali, Sengage Learning.	2011
5	Structural Analysis: A unified classical and matrix approach, A. Ghali, A M Neville and T G Brown, Spon Press	2003
6	Structural Analysis – II, S.S. Bhavikatti, Vikas Publishing House.	2011
7	Matrix Methods of Structural Analysis, S.S. Bhavikatti, I.K. International Publishing House Pvt. Ltd.	2011
8	Matrix Analysis ff Framed Structures, James M. Gere and William Weaver, Chapman and Hall.	1990

B. Tech. Civil Engineering

Course code: Course Title	Course Structure			Pre-Requisite
CE 205: Fluid Mechanics	L	T	P	NIL
	3	0	2	

Course Objective: To train undergraduate students about the basic concepts of Fluid Mechanics and fluid measurement techniques (concepts of fluid statics, fluid kinematics, and fluid dynamics)

S. No	Course Outcomes (CO)
CO1	Determine the fluid pressure and use various devices for measuring fluid pressure.
CO2	Calculate the hydrostatic force and use of law of conservation of mass for fluid flow.
CO3	Apply Bernoulli's equation to fluid flow problems and boundary layer theory to determine lift and drag forces on a submerged body.
CO4	Apply appropriate equations and principles to analyze pipe flow problems.
CO5	Use of different fluid flow measuring devices.

S. No	Contents	Contact Hours
UNIT 1	Introduction and Fluid Statics: Properties of fluids, types of fluids, and continuum principle. Basic definition, hydrostatic law, Pascal's law, manometers, hydrostatic forces on submerged surfaces, buoyancy.	8
UNIT 2	Kinematics of flow and Fluid dynamics: Types of flow, streamline, path line, principle of conservation of mass, velocity, acceleration, velocity potential and stream function, vorticity and circulation. Euler's equation, Bernoulli's equation, and their applications, Pitot tube, Venturimeter, Orifices, and mouth pieces.	8

UNIT 3	Laminar and turbulent flow in pipe: Laminar flow through pipes, Reynolds experiment, flow of viscous fluid in circular pipe: turbulent flow; loss of head due to friction in pipe, velocity distribution in pipe flow, flow through pipes, minor energy losses in pipes, hydraulic gradient and total energy line, equivalent pipe, power transmission through pipes.	8
UNIT 4	Dimensional analysis and models: Dimensional homogeneity, Rayleigh's and Buckingham's π theorem, dimensionless numbers, Types of models and model analysis.	8
UNIT 5	Boundary layer theory and Flow around Submerged bodies: Boundary layer definitions and characteristics, laminar and turbulent boundary layers, boundary layer thickness, laminar sub-layer, Forces exerted by flowing fluid on a resting body, drag and lift, streamlined body and bluff body, skin friction, drag on sphere, cylinder and flat plate.	10
	Total	42

REFERENCES		
S.No.	Name of Books/Authors/Publishers	Year of Publication / Reprint
1	Bansal, R. K. "Fluid Mechanics and Hydraulics Machines", Laxmi Publications(P) Ltd. (ISBN 81 7008 311 7).	2008
2	Garde, R.J. and Mirjankar, A.G. "Engineering fluid Mechanics", Nem Chand & Bros. (ISBN 81 88429 01 5).	2000
3	Kumar, K.L., "Engineering Fluid Mechanics", Eurasia Publishing House (P) LTD. (ISBN 81 219 0100 6).	2000
4	Ojha, C.S.P., "Fluid Mechanics and Machinery, OXFORD, University Press. (ISBN 01 19 569963 7).	2010
5	Subramanya, K., "Fluid Mechanics", TMH New Delhi. (ISBN 0-07-462446-6)Fluid Mechanics.	1997

B. Tech. Civil Engineering

Course code: Course Title	Course Structure			Pre-Requisite
CE206: Soil Mechanics	L	T	P	CE104: Mechanics of Solids
	3	1	2	

Course Objective: To help students understand the importance of Soil Mechanics in Civil Engineering by studying soil properties and various aspects of soil behavior under different circumstances and loadings. This is a core subject for Civil Engineers.

S. No.	Course Outcomes (CO)
CO1	Understand the importance of Soil Mechanics. Determination of Index properties, use of functional relationships. Knowing basic concepts of clay minerals and soil structure.
CO2	Identification of soils by their classification and determination of the hydraulic conductivity of soils.
CO3	Determination of seepage through soils and determination of compaction characteristics.
CO4	Determination of stress distribution below ground level due to various surcharges at the ground surface. Determination of shear strength under various drainage conditions.
CO5	Determination of various consolidation parameters and compressibility, and their field applications. Determination of Factor of Safety for infinite and finite slopes and critical failure surface.

S. No	Contents	Contact Hours
UNIT 1	Introduction: Introduction to soil mechanics, Rock Mechanics, and geotechnical engineering, importance in civil engineering, nature of soil, soil formation, and soil type. Simple Soil Properties: Basic definitions, phase relations, index properties, basic concepts of clay minerals, and soil structure	10
UNIT 2	Classification and Identification of Soil and Rock: Field identification, Textural Classification, Indian Standard Soil Classification system, Group Index. Hydraulic Conductivity or permeability, Darcy's law, Discharge and Seepage velocities, Laboratory methods of determination, Factors affecting hydraulic conductivity, Hydraulic conductivity of layered soils, Neutral and effective stresses, Critical hydraulic gradient, Capillary water in soils.	8
UNIT 3	Seepage: Laplace's equation for simple flow problems, Flow nets, Seepage calculation from flow nets, Flow nets in anisotropic soil, Seepage pressure, Uplift pressure, Seepage through earth dams, Exit gradient, Piping, Criteria for design of filters. Compaction: General principles, Laboratory determination, Factors affecting compaction, Field compaction.	8

UNIT 4	Stress Distribution: Boussinesq equation for vertical stress, The Westergaard equation, Stress distribution under different loaded areas, Shear Strength: Introduction, Mohr's circle of stress, Mohr-Coulomb failure theory, Shear strength parameters, Various Laboratory tests for measurement of shear strength, UU, CU, and CD tests and their relevance to field problems, Plotting of test data, Shear strength characteristics of clays, and sands.	8
UNIT 5	Compressibility and Consolidation: Importance of compressibility, effect of soil type, stress history, and effective stress on compressibility. Factors affecting consolidation and compressibility, Normally consolidated and over-consolidated soils, Void ratio-pressure relationship, Coefficient of compressibility and Volume change, Mechanism of consolidation, Terzaghi's theory of consolidation, Determination of Coefficient of Consolidation.	8
	Total	42

REFERENCES		
S.No.	Name of Books/Authors/Publishers	Year of Publication / Reprint
1	Basic and Applied Soil Mechanics, 5th edition, New Age International Publishers, New Delhi, Ranjan, Gopal, and Rao, A.S.R.	2023
2	Geotechnical Engineering 6th edition, New Age International Publishers, New Delhi, Venkatramiah, C.	2018
3	Soil Mechanics and Foundations 17th edition, Laxmi Publications (P) LTD, New Delhi, Punmia, B. C., Jain, Ashok Kumar, Jain, Arun Kumar.	2021
4	Principles of Geotechnical Engineering, 10th edition, Cengage Learning, New Delhi, Das, Braja M.	2022
5	Soil Engineering In Theory and Practice Volume 1, 4th edition or later, CBS Publishers & Distributors Pvt. Ltd., New Delhi, Singh, Alam.	2020

B.Tech. in Civil Engineering					
Course code: Course Title		Course Structure			Pre-Requisite
CE207: Surveying and Geoinformatics		L	T	P	NIL
Course Objective: To familiarize the students with the concepts of the subject and its related applications in Civil Engineering.					
S. No	Course Outcomes (CO)				
CO1	To develop an understanding of the basic concepts of surveying.				
CO2	To understand the use of different surveying instruments.				
CO3	To conceptualize how to use a set of survey techniques and equipment optimally.				
CO4	Understand the basic concept of Remote Sensing and know about different types of satellites, sensors, and data.				
CO5	Apply the concepts of photogrammetry and its applications, such as the determination of the heights of objects on terrain.				
S. No	Contents				
UNIT 1	Introduction: Importance of Surveying to Engineers; Plane and Geodetic surveying, Classification of surveys, Basic Principles of Surveying, Types of maps, scales, and uses, plotting accuracy, map sheet numbering, coordinate and map projection. Organization of field and office work. Project Surveys, Hydrographic Survey, Astronomy and Map making in India: General requirement and specifications of Engineering project surveys, Reconnaissance, Principles and practices, construction surveys, location and layout surveys. Hydrographic survey, shoreline, tidal and river surveys, soundings in hydrographic survey, Terms in astronomical survey, basics of spherical trigonometry. Map in the making-survey of India publication, conventional symbol charts, and different types of maps.				
UNIT 2	Survey Instruments, Measurement of Distances, Angles, Azimuths: Introduction to surveying equipment, chains, tapes, compasses, theodolites, tacheometers, EDM, total Stations, and other instruments, types of errors, sources of errors, and precautions. Chain, Compass and Plane Table Surveys: Chain survey procedures, errors and corrections, planning and carrying out a chain survey. Compass survey, types of compasses, and various terms related to magnetic compass, computing, and plotting a traverse. Plane table surveys and mapping.				
UNIT 3	Surveying Methods and Techniques - Levelling and measurement of elevations, different methods of levelling. Methods of control establishment, traversing, triangulation, trilateration, computation of coordinates, trigonometrical levelling, theodolite surveying and tachometry, contouring,				

	Curves: curve layout, horizontal, transition and vertical curves, Different types of survey projects.	
UNIT 4	Geoinformatics: Geospatial Sciences and Geospatial Technologies, Remote sensing, History of Remote Sensing, Remote sensing components, Sources of Energy, Electromagnetic spectrum, Spectral reflectance and reflectance curves, Radiation and Radiation Calculation, Platforms and Sensors: Orbital movement and Earth coverage. Types of Orbits, Types of resolutions, Active and passive remote sensing, Sensor's characteristics, Light and Earth surface Interactions, Indian Remote Sensing Satellite Program, Other satellites. GIS, Components of GIS, Raster and Vector data types, GIS Applications, Basic concepts of Geodesy and its Applications	8
UNIT 5	Aerial Photography, Photogrammetry and Digital Image Processing: Introduction, Early history of aerial photography, Basic principles of photogrammetry, image parallax, ground control for aerial photography, production of maps and ortho-photos, flight planning. Visual Image Interpretation: Introduction, fundamentals of Visual image interpretation, basic equipment used, elements of visual image interpretation, methods of search, and applications of visual image interpretation. Digital Image Processing: Introduction, image rectification and restoration, image enhancement, classification stage, training stage, hybrid classification, output stage, accuracy assessment, Remote sensing data collection: Types and Sources of Remote Sensing data, digital image data formats. Data Visualisation, DEMs, Image Processing Software.	10
	Total	42

REFERENCES

S. No.	Name of Books/Authors/Publishers	Year of Publication / Reprint
1	Punmia, B. C., "Surveying", Vol. II & III, Laxmi Publications, New Delhi (ISBN 69-85-0743-2)	2000
2	Kennie, T. J.M. and Petrie, G., "Engineering Surveying Technology", Blackie & Sons Ltd, London. (ISBN 39-12-6050-8)	1998
3	Bannister, A. and Baker, R., "Solving Problems in Surveying", Longman Scientific Technical, U.K. (ISBN 19-45-2494-7)	2000
4	Arora, K. R., "Surveying", Vol. II & III, Standard Book House, Delhi (ISBN 644-23-0774-4)	1999
5	Jensen, J.R., Digital Image Processing- A Remote Sensing Perspective, 4th ed., Pearson Education.	2000
6	Chandra, A.M. and Ghosh, S.K., "Remote Sensing and Geographical Information System", Narosa.	2000
7	Schowengerdt, R.A., "Remote Sensing – Models and Methods for Image Processing", Academic Press	2000

B. Tech. Civil Engineering

Course code: Course Title	Course Structure			Pre-Requisite
CE208: Environmental Engineering -1	L	T	P	CE205: Fluid Mechanics
	3	0	2	

Course Objective: This course aims to conceptualize various aspects of water treatment schemes from its raw water source to the end user. The course helps in working out the raw water requirements, planning the layout of treatment schemes, and transmission and distribution of drinking water to end users, considering factors like reliability, cost-effectiveness, and adherence to quality and quantity parameters. The course emphasizes understanding the concept of water treatment processes and engineering unit operations to develop the effective design of treatment plants.

S. No	Course Outcomes (CO)
CO1	To describe the qualitative and quantitative requirements of drinking water for a water supply scheme and the development of skills in identifying appropriate raw water sources.
CO2	To estimate the safe yield of groundwater wells and familiarize with using Renny walls as a source of raw water. Also, to design, test, and operate the pipe network to deliver treated drinking water.
CO3	To assess the capacity of the storage/distribution reservoir of treated drinking water. Also, familiarize with the requirements of water supply for small communities.
CO4	To understand fundamental concepts of various unit operations like aeration, coagulation & flocculation, settling, and filtration. Also, to understand the concept of the total energy line and the hydraulic requirements of any water treatment scheme.
CO5	To develop the layout and schematic diagrams for any water supply schemes and design the treatment units as per the CPHEEO Manual on Water Supply & Treatment.

S. No	Contents	Contact Hours
UNIT 1	Water demands estimates for projected population; Population forecasting using the logistic curve method; Sources of water and their characteristics; Quality and Quantity of surface and ground waters; physical, chemical, and biological water quality parameters; Drinking water quality requirements. Factors governing the selection of a source of water supply. The safe yield of a confined and unconfined aquifer, Radial collector wells. Intake structures and their design	8

UNIT 2	Methods of treatment and flow sheets as per the CPHEEO manual; Theory of Aeration, Coagulation & flocculation, Jar test, Settling, Types of settling (I to IV), Softening, Filtration, Disinfection, Concept of total energy line through unit operations; Hydraulics requirements, Schematic diagrams. Chemical computations in water treatment in respect to coagulation, alkalinity, and water softening.	8
UNIT 3	Designs as per CPHEEO manual: Design of spray-type aerator, Design of Mechanical Rapid Mix Unit, Design of Clariflocculator, Design of Sedimentation tank, Design of Settling tank, Design for tube settlers, Design for Rapid Gravity Filter.	8
UNIT 4	Various types of conduits , connections, and fittings. Design of economical size of rising main; Thrust Block, Laying and Testing of water supply pipelines. Types and capacities of pumps. Layout of distribution network, Storage capacity of distribution reservoir, and wastage of water in the distribution system. Hardy-Cross method, equivalent pipe method of pipe network analysis. Use of EPANET for water network analysis.	8
UNIT 5	Plumbing systems in buildings and houses: water connections, requirements for indoor water treatment units, and water supply for small communities. assessment of the need for the project, The Proposed Project, Institutional and Financial Aspects.	10
	Total	42

REFERENCES

S.No.	Name of Books/Authors/Publishers	Year of Publication / Reprint
1	Peavy, Howard S., Rowe, Donald R., and Tchobanoglous, George, "Environmental Engineering," McGraw-Hill Education (India) Pvt. Ltd., New Delhi.	1985
2	CPHEEO Manual on Water Supply & Treatment, Ministry of Urban Dev., GOI.	2009
3	Garg, S.K., "Water Supply Engineering, Vol 1", Khanna Publishers, New Delhi. (ISBN 0-07-6080479-3)	2022
4	Qasim, Syed, "Water Works Engineering: Planning, Design and Operation," Prentice Hall India Learning Private Limited.	2000

B. Tech. Civil Engineering

Course code: Course Title	Course Structure			Pre-Requisite
CE209: Analysis of Structure - I	L	T	P	CE104: Mechanics of Solid
	3	0	2	

Course Objective: To familiarize the students with the concepts of Analysis of Determinate Structures.

S. No	Course Outcomes (CO)
CO1	Identify different forms of structural systems.
CO2	Construct ILD and analyze the beams and trusses subjected to moving loads.
CO3	Determine the deflections of trusses, beams, and frames using Energy Methods
CO4	Determine deflection of beams using the Double Integration Method, Macaulay's Method, Moment Area Method, and Conjugate Beam Method.
CO5	Analyze three-hinged arches and cables under different loading conditions.

S. No	Contents	Contact Hours
UNIT 1	Introduction: Types of structural forms, conditions of equilibrium, compatibility conditions, Degree of freedom, Linear and non-linear analysis, Static and kinematic indeterminacies of structural systems.	8
UNIT 2	Influence Lines: Concepts of influence lines, ILD for reactions, SF and BM for determinate beams, ILD for axial forces in determinate trusses. Moving Loads: Reactions, BM and SF in determinate beams, axial forces in determinate trusses for rolling loads using ILD.	8
UNIT 3	Energy Principles and Energy Theorems: Principle of virtual work, Betti's Law, Strain energy due to axial force, bending, shear, and torsion, and complementary energy. Determination of Deflection of beams, trusses, and frames using total Strain Energy, Castigliano's theorems, and Unit Load Method.	8
UNIT 4	Deflection of Beams: Analysis of the determinate beams with the application of the Double Integration Method, Macaulay's Method, Moment area method, and Conjugate beam method.	8

UNIT 5	Arches and Cable Structures: Analysis of the three hinged parabolic and circular arches with supports at the same and different levels. Analysis of cables under point loads and UDL, and determination of the length of cables for supports at the same and at different levels.	10
	Total	42

REFERENCES		
S.No.	Name of Books/Authors/Publishers	Year of Publication / Reprint
1	Theory of Structures, Stephen P. Timoshenko and D. H. Young, McGraw-Hill International Book Editions.	1965
2	Theory of Structures (SMTS II), B. C. Punmia, A. K. Jain, A. K. Jain, Laxmi Publications Pvt. Ltd.	2004
3	Elementary Structural Analysis, A.K. Jain, Nem Chand & Bros. Publication.	2016
4	Structural Analysis, R.C. Hibbeler, Prentice Hall.	2012
5	Structural Analysis, Aslam Kassimali, Sengage Learning.	2011
6	Structural Analysis: A unified classical and matrix approach, A. Ghali, A M Neville and T G Brown, Spon Press.	2003
7	Strength of Materials: Vol. I: Elementary Theory and Problems, S. Timoshenko, CBS Publishers & Distributors Pvt. Ltd.	2004
8	Strength of Materials: Vol II, S. Timoshenko, CBS Publishers & Distributors Pvt. Ltd.	2002
9	Mechanics of Materials, James M. Gere and S. Timoshenko, CBS Publishers Pvt. Ltd.	2004
10	Structural Analysis – I, S.S. Bhavikatti, Vikas Publishing House.	2011

B. Tech. Civil Engineering

Course code: Course Title	Course Structure			Pre-Requisite
CE 210: Hydraulics & Hydraulic Machines	L	T	P	CE205: Fluid Mechanics
	3	0	2	

Course Objective: After successful completion of this course, i) Students must be able to understand the different types of flow and flow profiles in an open channel and design of most economic channel sections of different shapes and ii) They are also able to understand the types of hydraulic machines like various types of turbines and pumps with the details like work done, efficiencies and their design.

S. No	Course Outcomes (CO)
CO1	Differentiate between Pipe flow and Open channel flow, and various types of flows in open channel flow, like Uniform flow, gradually varied flow, and Rapidly Varied flow.
CO2	Design the most economical channel. Understand specific energy and its applications in channel transitions.
CO3	Derive the GVF equation, the RVF equation, and their applications like the Backwater curve, Hydraulic Jump, etc.
CO4	Describe how to calculate the work done and various efficiencies of different types of Turbines.
CO5	Describe how to calculate the work done and various efficiencies of different types of Pumps.

S. No	Contents	Contact Hours
UNIT 1	Flow in Open Channels (Uniform Flow): Types of flow in channel, Geometrical properties of channel section, velocity distributions and pressure distributions in open channel flows, open channel equations for uniform flow, most economical channel sections.	8
UNIT 2	Non-Uniform Flow in Open Channel : Specific energy, critical depth, concept of specific energy, alternate depths, specific energy diagram. Differential equation of GVF, Different types of flow profiles, Flow controls. Hydraulic jump.	8

UNIT 3	Open Channel Flow Measurements: Flow over notches and weirs, Channel transitions (Hump and change in width), channel flumes Broad crested weirs, sharp-crested weir Broad crested weirs, sharp-crested weir, ogee spillway, sluice gate flow and critical depth flumes & their applications, Channel transitions (Hump and change in width), channel flumes.	8
UNIT 4	Hydraulic Turbines and Impact of Jets: Hydrodynamic force of jets on stationary and moving flat, inclined and curved vanes, jet striking centrally and at tip, velocity triangles at inlet and outlet, expressions for Work done and efficiency-Angular momentum principle, Torque and head transferred in rotodynamic machines., Elements of hydroelectric power plants, head and efficiencies of hydraulic turbines, classification of turbines, Pelton wheel turbine, working proportions of Pelton wheel, Design of Pelton wheel runner, study and design of Francis turbine, Draft tube theory, Cavitation, Kaplan turbine, working proportions of Kaplan turbine, Efficiency, specific speed, unit quantities and velocity triangles.	10
UNIT 5	Centrifugal and Reciprocating Pumps: Introduction, components/parts and working of a centrifugal pump, work done by the impeller; heads, losses and efficiencies; minimum starting speed; Priming; reciprocating pumps, air vessels.	8
	Total	42

REFERENCES		
S.No.	Name of Books/Authors/Publishers	Year of Publication / Reprint
1	Bansal, R. K. "Fluid Mechanics and Hydraulics Machines", Laxmi Publications(P) Ltd. (ISBN 81 7008 311 7).	2008
2	R.K. Rajput, "A Text Book of Fluid Mechanics. Hydraulic Machines" S Chand & Company Ltd.	2004
3	Subramanya, K., "Theory And Application of Fluid Mechanics including Hydraulic Machines", TMH New Delhi (ISBN 0-07-460369-8).	2006
4	Subramanya, K., "Flow in Open Channels", TMH, New Delhi. (ISBN 0-07-462446-6).	1997

B. Tech. Civil Engineering

Course code: Course Title	Course Structure. Credit = 4			Pre-Requisite
CE301: Geotechnical Engineering	L	T	P	CE 206: Soil Mechanics
	3	0	2	

Course Objective: To familiarize the students with concepts of the subject and its related applications in Civil Engineering.

S. No	Course Outcomes (CO)
CO1	Introduction to the purpose and significance of soil exploration in geotechnical engineering.
CO2	To understand lateral earth pressure problems and plastic equilibrium in soils, including active, rest, and passive states.
CO3	To analyse the stability of infinite and finite slopes using various methods.
CO4	To understand the concept of shallow and pile foundations, their mechanism and design.
CO5	Introduction to machine and well foundations and their applicability on expansive soils.

S. No	Contents	Contact hours
UNIT 1	Soil Exploration: Purpose; Planning and reconnaissance; Various methods; Bore holes and depth of exploration; Sampling and samplers: Standard penetration test: Correlations between penetration resistance and strength parameters; Static cone test: Dynamic cone test; Plate Load test; Interpretation of test results; Indirect methods of soil exploration.	8
UNIT 2	Earth Pressures and Retaining Structures: Lateral earth pressure problems; Plastic equilibrium in soils, active and passive states; Earth pressure at rest, Rankine's theory of active and passive earth pressures; Active and passive earth pressure of cohesive soils: Coulomb's earth pressure theory: Graphical constructions to evaluate earth pressures; effect of surcharge and earthquake loading; earth pressure due to inclined backfills: Stability Analysis of retaining walls, choice of backfill material and importance of drainage; Bracings for open cuts. recommended design diagrams of earth pressure for typical soils; Earth pressure on cantilever and anchored sheet pile walls: Arching and its practical implications.	8
UNIT 3	Stability of Slopes: Factor of safety; Stability of infinite slopes; Stability of finite slopes; The Swedish circle method; Bishop's simplified method; Friction circle method; Taylor's stability number; Acceptable values of	8

	factor of safety: Critical conditions for the stability of earth dams; Road and earth dam embankments; Modes of failure and the usual protective measures; Slope inclinations usually adopted.	
UNIT 4	Shallow Foundations: Common types with illustrations of situations where each one of them is adopted; Terminology: Rankine's analysis; Terzaghi's bearing capacity theory; Types of failures; Bearing capacity computations in cohesionless and cohesive soils; General bearing capacity equation, Meyerhof's analysis, Effect of water table on bearing capacity; Bearing capacity on layered soil: Use of field test data; Foundation settlements; Components and limits of settlements'; Estimation of settlement of footings / rafts by using field and laboratory test data: Corrections for rigidity and 3-dimensional consolidation effects. Pile Foundations: Classification and uses of piles; Selection and installation of piles; Load carrying capacity of piles, dynamic and static formulae; Single pile and group actions; Pile load tests; Negative skin friction, Settlement of pile groups; Laterally loaded piles.	8
UNIT 5	Well Foundations: Situations where adopted; Types of wells or caissons; Elements of wells; Methods of construction: Tilt and shifts: Remedial measures; Depth and size of wells on the basis of scour depth: Bearing capacity and settlement; Terzaghi's lateral stability analysis. Introduction to Machine Foundations: Types of machines and their foundations; Terminology: Design criteria: Field methods of determining design parameters-Cyclic plate load test; Block vibration test; Response of block foundations under vertical vibrations. Foundation on Expansive Soils: Identification of expansive soil: problems associated with expansive soils: Design considerations of foundations on expansive soils; Under-reamed piles.	10
	TOTAL	42

List of experiments:

1. To determine shear strength parameters of soil direct shear test.
2. To determine shear strength parameters of soil using triaxial shear test.
3. To determine shear strength parameters of soil vane shear test.
4. To determine shear strength parameters of soil using unconfined compressive shear test.
5. To perform modified Proctor's test
6. To determine coefficient of consolidation of the soil
7. To determine permeability of soil by constant head permeameter.
8. To determine permeability of soil by falling head permeameter.

References		
S.No.	Name of Books/Authors/Publishers	Year of Publication / Reprint
1	Basic and applied soil mechanics by Gopalranjan and Rao, ASR (revised edition), New Age International, New Delhi. (ISBN 0-17-946826-2).	2000

2	Introduction to geotechnical engineering by Holtz R and Kovacs, WD, John Wiley New York. (ISBN 0-07-04452-2).	1999
3	Foundation analysis and design by Bowles., McGraw Hill (ISBN 0-07-037154-6).	1998
4	Soil Mechanics and Foundation engineering by VNS Murthy, Sai Kripa (ISBN 0-071-0498722-1).	2018
5	Scott, R.F., Foundation Analysis, Prentice Hall (ISBN 0-07-05429-5).	1981
6	Shukla, S.K Core Concepts of Geotechnical Engineering. ICE Publishing, London, UK.	2015

B. Tech. Engineering					
Course code: Course Title		Course Structure			Pre-Requisite
CE302: Design of Steel Structures		L	T	P	NIL
		3	1	0	

Course Objective: Fostering students' competence in the design of conventional steel structures components and their connections conforming to the relevant IS Codes.

S. No	Course Outcomes (CO)
CO1	Students can design tension and compression members using rolled & built-up sections.
CO2	Students can design flexural members using rolled & built-up sections.
CO3	Students can design various types of column bases.
CO4	Students can design splicing and beam-column connections.
CO5	Students can design roof trusses.

S. No	Contents	Contact Hours
UNIT 1	Materials, loads and their combinations, partial safety factors for loads and materials, design philosophies, fasteners and connections.	7
UNIT 2	Design of tension members, various sections, lug angles, splices, and gussets. Design of compression members, built-up members, lacing & batten plates, and column bases.	9
UNIT 3	Design of beams, sections classification, laterally supported and unsupported, web crippling and web buckling, un-symmetrical bending and their design.	9
UNIT 4	Design of beam column, plate girders with stiffeners in unbuckled and buckled state, splicing of web and flange components using different types of fasteners.	9
UNIT 5	Design of beam-column connections, purlins, and roof trusses.	8
	Total	42

REFERENCES		
S.No.	Name of Books/Authors/Publishers	Year of Publication / Reprint

1	Design of Steel Structures, A.S. Arya and Awadhesh Kumar. Nem Chand & Bros, Roorkee.	2014
2	Design of Steel Structures-: Limit States Method, N. Subramanian. Oxford University Press.	2016
3	Limit State Design of Steel Structures, S.K. Duggal. Tata McGraw-Hill Publishing Company Ltd., New Delhi.	2015
4	Limit State Design in Structural Steel, M.R. Shiyekar. PHI Learning Pvt. Ltd., New Delhi.	2010
5	Design of Steel Structures. N.R. Chandak. S.K. Katariya & Sons, New Delhi.	2017
6	Design of Steel Structures by Limit State Method, S.S. Bhavikatti. I.K. Publishing House Pvt. Ltd., New Delhi.	2011
7	Steel tables and IS: 800-2007, “General construction in steel”, BIS, New Delhi.	Latest

B. Tech. Engineering					
Course code: Course Title		Course Structure			Pre-Requisite
CE302: Environment Engineering-II	L	T	P	NIL	
	3	0	0		

Course Objective: This course aims to conceptualize various aspects of wastewater collection, treatment, disposal, and reuse. The course focuses on understanding wastewater generation, planning, and layout of sewerage systems, learning principles, and designing preliminary, primary, secondary, and tertiary treatment units for sustainable reuse and disposal of treated wastewater in lakes, rivers, and estuaries. This course also deals with sludge thickening and digestion. Assessment of the impact of treated wastewater disposal on river water quality is also undertaken in this course.

S. No	Course Outcomes (CO)
CO1	To analyse the sewer network, characteristics of wastewater, and assess the efficiency of various unit operations of wastewater treatment.
CO2	To decide the treatment train and design its various unit operations for effective treatment of wastewater and sludge.
CO3	To assess the impact of wastewater disposal on river water quality based on the Streeter-Phelps equation and the Qual-II model by the EPA.
CO4	To audit the existing wastewater treatment plant for gaps/inefficiencies and recommend appropriate augmentation of the treatment scheme.

S. No	Contents	Contact Hours
UNIT 1	Types of sewerage systems and their components, estimating municipal sewer discharge and storm discharge, operation and maintenance of sewers, quality characteristics of municipal sewage, BOD, COD, suspended solids, pH, and other important characteristics of sewage, variation in sewerage flow. Standards of wastewater/sewer discharge as per IS codes. Planning and financing of sewerage systems. Unit Operations and Processes (Physical, Chemical, Biological), layout of sewage treatment plant.	7
UNIT 2	Hydraulic Design of Sewers and stormwater drains: Design of circular and egg-shaped sewers, freeboards in sewers, hydraulics formulae for flow velocities, self-cleaning and non-scouring velocity, hydraulic characteristics of circular sewers running full and partially full. Forces acting on sewer pipes, need for the design of thrust blocks. Pumps for lifting sewers. Sewer pipe materials, sewer construction and maintenance, Sewer Appurtenances; manholes, storm water inlets, catch basins, sewer ventilators etc.	8
UNIT 3	Preliminary and Primary Treatment Units: Theory and design principles of Screens, Grit Chambers, Oil and Grease removal, Skimming Tanks, Primary Sedimentation Tank, inlet-outlet arrangements. Design of preliminary and primary treatment units based on CPHEEO manual.	8

UNIT 4	Secondary Treatment: Principles of biological wastewater treatment, growth and food utilization, suspended and attached growth systems, basic concepts and design of various components of activated sludge process-based treatment system, trickling filters, oxidation ponds, lagoons, and oxidation ditches, Secondary clarification. Designs of activated sludge plants, trickling filters, oxidation ponds, and secondary clarification based on CPHEEO manual. Rural sanitation practices, design of septic tank. Anaerobic processes, design of anaerobic filter and anaerobic digester.	12
UNIT 5	Introduction to environmental studies- Definition, scope, and importance, natural resources, renewable and non-renewable resources, Social issues and the environment, human population and environment	7
	Total	42

REFERENCES

S.No.	Name of Books/Authors/Publishers	Year of Publication / Reprint
1	Metcalf & Eddy “Wastewater Engineering: Treatment and reuse”, McGraw Hill Education.	2017
2	Peavy, Howard S., Rowe, Donald R. and Tchobanoglous, George, “Environmental Engineering” McGraw Hill Education (India) Pvt. Ltd., New Delhi.	1985
3	CPHEEO Manual on Sewerage and Sewage Treatment, Ministry of urban Development, New Delhi.	1983
4	S.K. Garg, “Sewage Disposal and Air Pollution Engineering”, Khanna Publishers.	2024

B. Tech. Engineering					
Course code: Course Title		Course Structure			Pre-Requisite
CE 304: Water Resources Engineering	L	T	P	NIL	
	3	0	2		

Course Objective: The course aims to equip students with the knowledge and skills necessary for designing, analysing, and managing water resources efficiently while considering environmental, economic, and sustainability aspects.

S. No	Course Outcomes (CO)
CO1	Assess different methods of irrigation and drainage, and understand the fundamental concepts of river morphology.
CO2	To analyse and design the structures such as notch falls, Sharda falls, and the design of an aqueduct and a siphon aqueduct.
CO3	To analyse and design the Regulation works and Cross-Drainage structures such as dams, spillways, and weirs.
CO4	Understand the fundamentals of hydrology, including precipitation, runoff, and infiltration processes.
CO5	Evaluate groundwater flow, well hydraulics, and aquifer characteristics for sustainable water extraction.

S. No	Contents	Contact Hours
UNIT 1	Irrigation and Drainage works: Necessity and types of irrigation, soil moisture and crop water relations, consumptive use of water, water logging, design concepts of surface and sub-surface drainage system. Rivers and River training works: Rivers of different types, river behaviour, meanders, cut offs, river training works and their design. Canal irrigation: Types of reservoirs, reservoir yield, reservoir losses, multi-purpose river valley projects. Types of canal, parts of canal irrigation system, assessment of water requirements, estimation of channel losses, design of lined and unlined channels, regime and semi-theoretical approaches (Kennedy's theory and Lacey's theory). Modular and non-modular outlets.	12
UNIT 2	Regulation works and Cross-Drainage structures: Classification of falls and their suitability, design of notch falls, Sharda falls and Montague falls, distributary head regulators and escapes. Necessity of cross-drainage structures, their types and selection, comparative merits and demerits, design of aqueduct and siphon aqueduct.	7

UNIT 3	Diversion Head works: Selection of site and layout, different parts of diversion head works, types of weirs and barrages, design of weirs on permeable foundation barrage by Bligh's and Khosla's methods. Silt excluders and silt ejectors. Dams and Spillways: Introduction, suitable sites, types of dams, forces acting on a gravity dam, stability requirements, arch dams, buttress dams, earth and rock-fill dams, design of gravity dams. Introduction, types of spillways, design of spillways, energy dissipation below spillways.	8
UNIT 4	Hydrology: Hydrologic cycle, rain gauge, measurement of rainfall, rainfall analysis, infiltration, runoff estimation; Stream flows and their measurement, Stage-discharge curves, Unit & Synthetic hydrographs and their applications, flood hydrograph. Peak flows estimation and flood frequency analysis. Reservoir routing and channel routing.	10
UNIT 5	Ground water engineering: Aquifers, movement of ground water, steady and unsteady flow towards wells in confined and unconfined aquifers, well losses.	5
	Total	42

REFERENCES		
S. No.	Name of Books/Authors/Publishers	Year of Publication / Reprint
1	Subramanya, K., "Engineering Hydrology", Tata McGraw-Hill Education Private Limited(ISBN 0-07-75158-4)	2015
2	Patra, K, C, "Hydrology and Water Resources Engineering", Narosa Publishing House(ISBN 0-07-06472-59-8).	2002
3	Viessman Jr., W., and Lewis, G. L. "Introduction to Hydrology", Prentice Hall of India Pvt. Ltd. (ISBN 0-07-478214-1)	2008
4	Garg, S.K, "Irrigation Engineering and Hydraulic Structures", Khanna Publishers, New Delhi. (ISBN 0-07-06487-1)	2014
5	Modi P. N., "Irrigation Water Resources and Water Power Engineering", Standard Book House, Delhi. (ISBN 0-07-078546-7).	1990
6	Asawa, G. L. "Irrigation and Water Resources Engineering", New Age International Publishers. (ISBN 0-07-795568-3)	1993

B. Tech. Engineering					
Course code: Course Title		Course Structure			Pre-Requisite
CE305: Transportation Engineering		L	T	P	NIL
		3	0	2	

Course Objective: This course aims to expose the civil engineering students to various fields of transportation engineering including material testing and quality control in highway projects. This course will deal with various aspects of planning, designing, construction and maintenance of the highways, railways, airports, tunnels, harbours and docks.

S. No	Course Outcomes (CO)
CO1	To expose students to carry out various traffic studies and experiment of the properties of highway materials
CO2	To expose students to the elements of design of highway geometry and highway pavements
CO3	To expose students to geometric design of railway track, concept of points and crossings, signals and track maintenance
CO4	To expose students to airport planning and design of runway, taxiway and various navigational aids
CO5	To expose students to the basic features of planning and design of tunnels and harbours

S. No	Contents	Contact Hours
UNIT 1	Introduction: Role of Transportation, Modes of Transportation, their importance and limitations, Planning and Engineering surveys, Basic requirements of alignment, Controlling factors for alignment.	6
UNIT 2	Highways: Geometric design elements of highways, highway materials, highway construction, highway pavements, traffic studies, traffic control devices, highway drainage and maintenance.	10
UNIT 3	Railways: Elements of Permanent way, wear and creep of rails, geometric design, track resistance and tractive power, points and crossings, design of turnout, stations and yards, signaling and interlocking, modernization of railway tracks.	10
UNIT 4	Airports: Classification of airports, obstruction and zoning laws, typical layout of airport, design of runway, design of taxiway, marking and lighting.	8
UNIT 5	Tunnel, Harbour and Docks: Types of tunneling, methods of tunneling, classification of harbours, breakwaters and types of docks.	8
	Total	42

REFERENCES

S.No.	Name of Books/ Authors/ Publishers	Year of Publication / Reprint
1	Khanna, S. K., Justo, C.E.G. and Veeraragavan A. "Highway Engineering", Nem Chand & Bros., Roorkee.	2014
2	Kadiyali, L. R., "Traffic Engineering and Transportation Planning", Khanna Publishers, New Delhi.	2018
3	Saxena, S. C. and Arora, S. P., "A Text Book of Railway Engineering", Dhanpat Rai & Sons, Delhi.	2003
4	Khanna S.K., Arora M.G. and Jain S.S., "Airport Planning and Design" Nem Chand & Bros., Roorkee.	2022
5	Srinivasan R., "Harbour, Dock and Tunnel Engineering" Charotar Publishing House Anand, Gujarat.	2016
6	Khanna, S. K., Justo, C.E.G. and Veeraragavan A. "Highway Materials and Pavement Testing", Nem Chand & Bros., Roorkee.	2013