

Course Curriculum
Third Year
B. Tech. in Civil Engineering
In line with National Education Policy 2020
(Effective from AY 2025-26 for University Department only)



Dr. Babasaheb Ambedkar Technological University
Lonere 402 103, Dist- Raigad, Maharashtra, INDIA

Established vide Maharashtra Act No. XXII of 1989 and Act. No. XXIX of 2014
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Dr. Babasaheb Ambedkar Technological University, Lonere

Teaching & Evaluation Scheme for Third Year B. Tech. Civil Engineering

Sr. No.	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credits
			L	T	P	ISE	MSE	ESE	Total	
Semester-V										
1	25UD1191PC501	Structural Mechanics-II	3	0	0	20	20	60	100	3
2	25UD1191PC502	Design of Steel Structures	3	0	0	20	20	60	100	3
3	25UD1191PC503	Open Channel Flow & Hydraulics Machines	3	0	0	20	20	60	100	3
4	25UD1191PC504	Geotechnical Engineering	3	0	0	20	20	60	100	3
5	24UD1ARPOEM05	Open Elective-III (From Bucket)	3	0	0	20	20	60	100	3
6	Refer Bucket	Multi-Disciplinary Minor-II (From Bucket)	3	0	0	20	20	60	100	3
7	25UD1191PCL507	Design of Steel Structures Lab	0	0	2	50	-	50	100	1
8	25UD1191PCL508	OCF & HM Lab	0	0	2	25	-	25	50	1
9	25UD1191PCL509	Geotechnical Engineering Lab	0	0	2	50	-	50	100	1
10	25UD1191HM510	Soft Skills Development	0	2	0	-	-	-	AU	GR
11	25UD1191VS511	Construction Equipment and Site Safety Management	0	2	0	25	-	25	50	2
TOTAL			18	4	6	270	120	510	900	23
Semester-VI										
1	25UD1191PC601	Design of Concrete Structures	3	0	0	20	20	60	100	3
2	25UD1191PE602	Program Elective-I	3	0	0	20	20	60	100	3
3	25UD1191PE603	Program Elective -II	3	0	0	20	20	60	100	3
4	25UD1191PE604	Program Elective-III	3	0	0	20	20	60	100	3
5	25UD1191PC 605	Foundation Engineering	3	0	0	20	20	60	100	3
6	Refer Bucket	Multi-Disciplinary Minor-III (From Bucket)	3	0	0	20	20	60	100	3
7	25UD1191PCL607	Concrete Structures Lab	0	0	2	50	-	50	100	1
8	25UD1191PEL608	Program Elective-II- Lab	0	0	2	25	-	25	50	1
9	25UD1191PEL609	Program Elective-III- Lab	0	0	2	25	-	25	50	1
10	25UD1191EL610	Seminar	0	0	2	25	-	25	50	1
11	25UD1191VS611	Academic Research Writing	1	0	0	25	-	25	50	1
12	25UD1191EL612	Project Phase-I	0	0	4	50	-	50	100	2
TOTAL			19	0	12	320	120	560	1000	25

Course Type	Course Code	Course Name	Course Type	Course Code	Course Name
Program Elective-I	25UD1191PE602A	Hydraulics Structures	Open elective-III	24UD1ARPOEM05H	Geomatics Engineering
	25UD1191PE602B	Irrigation Engineering		24UD1ARPOEM05O	Ground Improvement Techniques
Program Elective-II	25UD1191PE603A	Water Quality Engineering		24UD1ARPOEM05P	Sustainable Construction Methods
	25UD1191PE603B	Environment Health and Safety	Multi-Disciplinary Minor-II	Refer Bucket	Refer Bucket
Program Elective-III	25UD1191PE604A	Highway & Railway Engineering	Multi-Disciplinary Minor-III	Refer Bucket	Refer Bucket
	25UD1191PE604B	Intelligent Transportation Systems			
	25UD1191PE604C	Traffic Engineering & Management			

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Program Elective-III	25UD1191PE604A	Highway & Railway Engineering	Multi-Disciplinary Minor-III	Refer Bucket	Refer Bucket
	25UD1191PE604B	Intelligent Transportation Systems			
	25UD1191PE604C	Traffic Engineering & Management			

Detailed Course Contents

SUBJECT CODE		Structural Mechanics-II					CREDITS	
25UD1191PC501							3	
Teaching Work Load/week(Hrs.)				Examination Scheme (Marks)				
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total	
3	0	0	03	20	20	60	100	

Course Outcomes: Students will be able to	
COBJ1	To learn concept of influence line and moving load analysis
COBJ2	To learn structural response behavior of bridges and arches
COBJ3	To understand forced based method of structural analysis
COBJ4	To understand displacement-based method of structural analysis
COBJ5	To understand concepts related to finite difference and finite element methods

Course Outcomes: On completion of course, students will be able to	
CO1	Have a basic understanding of concept of influence line and moving load analysis
CO2	Have a basic understanding of structural response behavior of bridges and arches
CO3	Have a detailed understanding of forced based method of structural analysis
CO4	Have a detailed understanding of displacement-based method of structural analysis
CO5	Have a basic understanding of the principles and concepts related to finite difference and finite element methods

Course Contents

Application of all methods shall be restricted to beams, Frames and /or pin jointed frames or trusses of Degree of Indeterminacy up to three.

Module 1	Analysis of trusses	Hrs. 6
<p>Analysis of determinate and indeterminate pin jointed trusses by energy method, effects of settlement and pre-strains</p> <p>Moving Loads and Influence Lines- Introduction to moving loads, concept of equivalent UDL, absolute maximum bending moment and shear force, concept of influence lines, influence lines for reaction, shear force, bending and deflection of determinate beams, influence line diagram (ILD) for forces in determinate frames and trusses, analysis for different types of moving loads, single concentrated load, several concentrated loads, uniformly distributed load shorter and longer than span, application of Muller Breslau principle for determinate structures to construct ILD.</p>		
Module 2	Cables, Suspension Bridges and Arches	Hrs. 8
<p>Analysis of forces in cables, suspension bridges with three hinged and two hinged stiffening girders, theory of arches, Eddy's theorem, circular, parabolic and geometric arches, concept of radial shear force and axial thrust, analysis of three hinged and two hinged arches, effect of yielding of supports, rib shortening and temperature changes. ILD for 3 hinged arches and suspension bridges.</p>		

Module 3	Analysis of Indeterminate Structures by direct Flexibility Method	Hrs. 8
Fundamental concepts of flexibility method of analysis, flexibility coefficients and their use in formulation of compatibility equations, application of above methods to propped cantilevers, fixed beams, continuous beams, simple pin jointed frames including effect of lack of members, rigid jointed frames.		
Module 4	Analysis of Indeterminate Structures by direct Stiffness Method	Hrs. 9
Fundamental concepts of stiffness method of analysis, stiffness coefficients for prismatic members and their use for formulation of equilibrium equation, applications of the above methods to indeterminate beams and simple rigid jointed frames, rigid jointed frames with inclined member but having only one translational DoF in addition to rotational DoF's, including the effect of settlement of supports, pin jointed frames.		
Module 5	Finite Element Method (Contents to conceptual level)	Hrs. 9
Introduction to analysis by discretization such as finite difference method, Finite element method: types of elements-1D, 2D, 3D, Plane Strain and Plane Stress Problem, isoperimetric and axisymmetric, convergence criteria, Pascal's triangle, direct stiffness method, principle of minimum potential energy. Shape functions, concept of local and global stiffness matrix		

Text Books:	
1	Reddy C. S., “Basic Structural Analysis”, Tata McGraw Hill
2	Pandit G. S. and Gupta S. P., “Structural Analysis - a Matrix Approach”, Tata McGraw Hill, N.Delhi,
3	Chandrupatla T. R., Belegundu A. D., “Introduction to Finite Elements in Engineering, Prentice Hall
4	Thadani B. N. and Desai J. P., “Structural Analysis”
5	Punmia B.C., “Structural Analysis”, Laxmi Publications
6	Vazirani V.N., Ratwani M.M and Duggal S.K., “Analysis of Structures - Vol. II” Khanna Publishers, N. Dehli, Sadhu Singh, “Theory and Solved Problems in Adv. Strength of Materials”, Khanna Publishers, N. Dehli,
7	Ramamrutham S. and Narayanan R., “Theory of Structures” Dhanpat Rai Publishers, Delhi
Reference Books:	
1	Norris C. H. and Wilbur J. B., “Elementary Structural Analysis”, McGraw Hill
2	Beaufait F.W., “Basic Concepts of Structural Analysis”, Prentice Hall, N.J. Kinney J. S., “Indeterminate Structural Analysis”, Oxford and IBH
3	Krishnamurthy, C.S., “Finite Element Analysis – Theory and Programing”, Tata McGraw Hill
4	Hibbler R. C., “Structural Analysis”, Pearson Publications
5	Kanchi M. B., “Matrix Methods of Structural Analysis”, Wiley Eastern Ltd., N. Delhi
6	Wang C. K., “Matrix Methods of Structural Analysis”, International Text-book, Scranton, Pennsylvania,
7	Gere J.M., Weaver W., “Analysis of Framed Structures”, D. Van Nostrand Company, Inc.

SUBJECT CODE		<h1>Design of Steel Structures</h1>						CREDITS
25UD1191PC502								3
Teaching Work Load/week (Hrs.)				Examination Scheme (Marks)				
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total	
3	0	0	03	20	20	60	100	

Pre-requisite: Engineering Mechanics, Mechanics of Solids, Structural Mechanics

Course Objectives	
COBJ1	Understand the fundamental concepts, advantages, and limitations of steel structures and their applications in civil engineering.
COBJ 2	Apply relevant IS codes to analyze and design tension members, compression members, beams, and connections.
COBJ 3	Design welded, bolted, and riveted connections for various structural components under different loading conditions.
COBJ 4	Analyze and design industrial roofing systems, gantry girders, and trusses considering load combinations and serviceability.
COBJ 5	Incorporate modern design approaches such as Plastic Analysis and Limit State Method in structural steel design.

Course Outcomes: On completion of course, students will be able to	
CO1	Explain the properties, permissible stresses, and design philosophies for steel structures.
CO2	Calculate load carrying capacities and design tension members, beams, and compression members as per IS.
CO3	Design and detail bolted, welded, and riveted joints to ensure structural safety and serviceability.
CO4	Perform structural design for industrial sheds, gantry girders, and truss members with appropriate load combinations.
CO5	Apply Limit State Method and Plastic Analysis concepts to evaluate and design steel members and frames.

Course Contents

Module 1	Introduction and Connections	Hrs. 08
Introduction, advantages & disadvantages of steel structures, permissible stresses, factor of safety, methods of design, various types of standards rolled sections, types of loads and load combinations. Design of connections- Riveted, Bolted, welded, Permissible Stresses, failure of joint		
Module 2	Tension and Flexure Members	Hrs. 08
Tension members: Common sections, net effective area, load capacity, connection using weld / bolts, design of tension splice connection using weld / bolt. Beams: Laterally supported & unsupported beams, design of simple beams, built up beams using flange plates, curtailment of flange plates, web buckling & web crippling, secondary and main beam arrangement, beam to beam connections.		
Module 3	Compression members and Column Bases	Hrs. 09

<p>Compression members: Common sections used, effective length and slenderness ratio, permissible stresses, load carrying capacity, Simple and built-up section, lacing, battening, column subjected to axial force and bending moment, column splices.</p> <p>Column bases: Analysis and design of: Slab base, gusseted base and moment resisting bases, grillage foundation, design of anchor bolt</p>		
Module 4	Industrial Roofing	Hrs. 07
<p>Gantry girder: Forces acting on a gantry girder, commonly used sections, introduction to design of gantry girder as laterally unsupported beam, connection details.</p> <p>Roof trusses: Components of an industrial shed, types of trusses, load calculations and combinations, design of purlins, design of truss members, design of hinge & roller supports.</p>		
Module 5	Introduction to Plastic Analysis and Limit State method	Hrs. 06
<p>Introduction to: Plastic Analysis, Hinge Formation, Collapse Mechanism, Recent approaches in Steel Structure design based on Plastic Analysis Method and Limit State Approach, Introduction to Provisions in IS 800-2007.</p>		

Text Books:	
1	Duggal S. K., “Design of Steel Structures”, Tata McGraw Hill Pub. Co. Ltd., New Delhi
2	Gambhir, “Fundamentals of Structural Steel Design”, Tata McGraw Hill Pub. Co. Ltd., New Delhi
3	Negi L. S., “Design of Steel Structures”, Tata McGraw Hill Pub. Co. Ltd., New Delhi
4	Chandra Ram, “Design of Steel Structures”, Vol. I & Vol. II, Standard Book House, New Delhi
5	Dayaratnam P., “Design of Steel Structures”, Wheeler Publishing, New Delhi
6	Subramanian N., “Steel Structures: Design and Practice” Oxford Univ. Press, Delhi
7	Vazirani V.N. and Ratwani M.M., “Design and Analysis of Steel Structures”
8	Sai Ram K. S., “Design of Steel Structures”, Pearson Education, 2nd Edition
Reference Books:	
1	Arya A. S. and Ajamani J.L., “Design of Steel Structures”, Nemchand and Brothers, Roorkee
2	Vazirani&Ratwani, “Design of Steel Structures”, Standard Book House, New Delhi
3	Duggal S. K., “Limit State Design of Steel Structures”, Tata McGraw Hill Pub. Co. Ltd., New Delhi
4	Publications of Bureau of Indian Standards, New Delhi, IS 800:1984, 2007, IS 875 (Part I to V)
5	Gaylord E.H. and Gaylord C.N., “Design of Steel Structures” McGraw Hill, New York
6	Lothers J.E., “Design in Structural Steel” Vol.-I, Prentice Hall New Jersey
7	Salmon and Johnson, “Steel Structures: Design and Behaviour”, Harper and Row, New York
8	Steel Designers Manual.

SUBJECT CODE		Open Channel Flow & Hydraulics Machines				CREDITS	
25UD1191PC503						3	
Teaching Work Load/week (Hrs.)				Examination Scheme (Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
3	0	0	03	20	20	60	100

Pre-requisite: Hydraulics Engineering

Course Objectives	
COBJ1	To understand fluid mechanics by exploring the types and properties of flow in open channels and weir calibration.
COBJ2	To understand and apply principles of uniform flow and specific energy.
COBJ3	To analyze non-uniform flow, including gradually and rapidly varied flow, hydraulic jumps, surges.
COBJ4	To study the impact of jets and the operation and selection of hydraulic turbines.
COBJ5	To learn about the classification, components, performance, and selection criteria of various types of pumps.

Course Outcomes: Students will be able to	
CO1	To identify types of channels and flows in open channels, measure velocity, calibrate weirs, and calculate discharge and reservoir emptying times.
CO2	Apply Chezy's and Manning's equations to design efficient channel sections, compute uniform flow, and understand specific energy concepts and flow states.
CO3	Analyze gradually and rapidly varied flow, compute energy losses, classify hydraulic jumps, and understand surges in open channels.
CO4	Apply the impulse momentum principle, analyze jet impacts, understand the working principles and selection criteria of hydraulic turbines, and address cavitation issues.
CO5	Classify and describe the components and workings of various pumps, evaluate their performance, and select appropriate pumps for different conditions.

Course Contents

Module 1	Flow in Open Channel	7 Hrs.
Introduction, Types of channels, Types of flow in open channels, Geometric properties of open channel, Velocity distribution, Measurement of velocity-pitot tube and current meter, Weirs and notches- Flow over sharp, broad, round crested weir or notch, Calibration of weir, Ogee and Siphon spillway, Empirical formulae for discharge over weir, Time required to empty a reservoir.		
Module 2	Uniform Flow and Specific Energy	7 Hrs.
Uniform Flow- Chezy's and Manning's equation, Most efficient channel section-design and consideration, computation of uniform flow.		
Module 3	Non-uniform Flow in Open Channel	9 Hrs.
Gradually Varied Flow- Dynamic equation of gradually varied flow and conditions, Classification of channel bottom slopes, Classification and characteristics of surface profiles with practical examples, Step method of		

integration of varied flow equation.		
Module 4	Impact of Jet and Hydraulic Turbines	7 Hrs.
Impact of Jet- Impulse momentum principle, Impact of jet on flat and curved vanes (Stationary and Moving), Inlet and outlet velocity triangles under various conditions, Series of Flat and Curved vanes mounted on wheel.		
Module 5	Pumps	6 Hrs.
Classification of pumps, Components and working of reciprocating and centrifugal pump, Performance of pumps, Selection of pumps under various conditions, Condition of self-priming, Introduction to different types of pumps- Multi-stage, Jet, Air lift, Submersible pump.		

Text Books:	
1	Hydraulics and Fluid Mechanics including Hydraulics Machines by Dr. P. N. Modi and Dr. S. M. Seth.
2	A Textbook of Fluid Mechanics and Hydraulic Machines by Dr. R. K. Bansal, Laxmi Publications.
3	Flow in open channels by K. Subramanya, McGraw-Hill Higher Education.
4	Open channel hydraulics by Ven Te Chow, McGraw-Hill Book Company.
5	Fluid Mechanics by K. L. Kumar, S. Chand publication. ISBN: 81-219-0100-6
6	A Textbook of Hydraulics Engineering by N.H. Kulkarni, TECHSAR Publications.
Reference Books:	
1	Fluid Mechanics including Hydraulic Machines by A. K. Jain, Khanna Publishers.
2	Introduction To Fluid Mechanics by Philip J. Pritchard, John Wiley & Sons, INC.
3	Introduction to Fluid Mechanics & Fluid Machines by S. K. Som & G. Biswas, Tata McGraw-Hill.
4	Fluid Dynamics by V. L. Streeter, K. W. Bedford and E. B. Wylie, New York, McGraw-Hill.

SUBJECT CODE		<h1>Geotechnical Engineering</h1>					CREDITS	
25UD1191PC504							3	
Teaching Work Load/week (Hrs.)				Examination Scheme (Marks)				
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total	
3	0	0	3	20	20	60	100	

Course Objectives	
COBJ1	To understand the index properties of soil and its classification.
COBJ2	To study the mechanics of compaction and clay mineralogy.
COBJ3	To learn the concept of permeability and dewatering.
COBJ4	To know how to evaluate the quantity of seepage discharge.
COBJ5	To study the shear strength of soil
COBJ6	To understand the stress distribution & consolidation of soil

Course Outcomes: Students will be able to	
CO1	Classify soil based on index properties of soil.
CO2	Explain the principal of compaction and demonstrate quality control in field.
CO3	Determine the permeability of soil and explain methods of dewatering.
CO4	Evaluate the quantity of seepage discharge and design criteria of graded filter.
CO5	Measure the shear strength of different types of soil using various methods.

Course Contents

Module 1	Introduction	Hrs. 10
History of development of soil mechanics, formation of soil, its significance to the field problems. Soil properties and its classification, Definition of soil, soil as a three-phase system, weight volume relationship, Index properties of course and fine-grained soil, BIS classification of fine grained and coarse-grained soil.		
Module 2	Compaction of Soil	Hrs. 7
Mechanics of compaction, factors affecting compaction, standard and modified Proctor test, their field Determination, zero air void line, concept of wet of optimum and dry of optimum, different structures of soil, field compaction and their control, CBR test and CBR values for soaked and unsoaked conditions.		
Module 3	Permeability of Soil	Hrs. 7
Darcy's law and its validity, discharge and seepage velocity, factors affecting permeability, determination of coefficient of permeability in laboratory and field, permeability for stratified soil deposits, drainage and dewatering of soil and its various methods.		
Module 4	Shear Strength and Seepage Analysis	Hrs. 10
A physical concept of shear strength, introduction of Mohr's stress diagram, Mohr's failure criteria, Mohr-		

Coulomb's theory and development of failure envelopes, unconfined compression test, laboratory measurement of shear strength for different drainage conditions by direct shear test, triaxial test, merits and demerits of various shear strength tests. Laplace equation and its derivation in Cartesian coordinate system, its application for the computation of discharge seepage, seepage pressure, quick sand condition, concept of flow net, characteristics and uses of flow net, preliminary problem of discharge, estimation of discharge through homogenous earthen embankment, Terzaghi's design criteria for graded filter, concept of piping and criteria of stability against piping		
Module 5	Stresses in soils	Hrs. 7
State of stress at a point, stress distribution in soil mass, Boussinesq's theory and its applications, point load and uniformly loaded area, Newmark's Influence Chart, its preparation and use. Consolidation of Soil: Definition, Spring analogy, Terzaghi's theory of one-dimensional consolidation, Consolidometer test,		

Text Books:	
1	Kasamalkar B. J., "Geotechnical Engineering", Pune Vidyarthi Griha Prakashan Pune
2	Murthy V.N.S., "Soil Mechanics & Foundation Engineering", U.B.S. Publishers and Distributors N. Delhi
3	Punmia B.S., "Soil Mechanics & Foundation Engineering", Laxmi Publications
4	Arora K. R., "Soil Mechanics" Standard Publishers, N. Delhi
5	Dr. B.C.Punmia A.K.Jain, "Soil Mechanics and Foundations" Laxmi Publications(P)Ltd
6	Gopal R Rao "Basic Soil Mechanics "
Reference Books:	
1	Alam Singh, "Text book of soil mechanics in theory and practice", Asian Pub. House, Mumbai
2	Taylor D.W., "Fundamentals of Soil mechanics"
3	Terzaghi and Peak "Soil mechanics" John Willey and Sons, New-York
4	Scott R. F., "Principal of soil mechanics"
5	Lambe T.W, "Soil Testing" by Willey Eastern Ltd., New Delhi

SUBJECT CODE		OPEN ELECTIVE-III					CREDITS	
24UD1ARPOEM05		Geomatic Engineering					3	
Teaching Work Load/week (Hrs.)				Examination Scheme (Marks)				
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total	
3	0	0	02	20	20	60	100	

Pre-requisite:

Course Objectives	
COBJ1	To introduce the fundamentals and principles of remote sensing.
COBJ2	To understand image interpretation and digital image processing techniques.
COBJ3	To learn the concepts and implementation of spatial databases and spatial analysis.
COBJ4	To comprehend the components, functions, and applications of GIS.
COBJ5	To explore the implementation steps and real-life applications of GIS in civil engineering and related domains.

Course Outcomes: On completion of course, students will be able to	
CO1	Explain the principles and components of remote sensing systems and satellite platforms.
CO2	Perform visual and digital interpretation of remotely sensed data for terrain analysis.
CO3	Apply spatial database concepts and analysis techniques for data management and decision-making.
CO4	Understand the fundamentals and operational principles of GIS, including data models and projections.
CO5	Analyze and implement GIS applications in civil engineering, planning, hazard assessment, and business.

Course Contents

Module 1	Concepts of Remote Sensing	Hrs. 08
Basics of remote sensing, elements involved, electromagnetic spectrum Terminology & units, energy resources, energy interactions with Earth surface & atmosphere Atmospheric effects, Remote sensing platforms and sensors, satellite orbits, sensor resolutions, types of sensors, IRS, and Landsat satellites series.		
Module 2	Remote Sensing Data Interpretation & Digital Image Processing	Hrs. 08
Visual interpretation techniques, elements, converging evidence, Spectral signature, Spectral properties of soil, water, vegetation, Digital image and properties, Concepts of digital image processing, image enhancement, Pattern recognition, classification techniques, and accuracy estimation.		
Module 3	Spatial DBMS & Analysis	Hrs. 08
Spatial DBMS: data storage, DBMS structure models, Entity Relationship model, normalization. Spatial Analysis: topology, vector & raster data analysis, network analysis, Data interpolation techniques, data input: keyboard, digitization, scanning, remotely sensed data.		

Module 4	Introduction to GIS	Hrs. 08
History and components of GIS, applications and integration of remote sensing, Nature of geographic data, types of maps and scales, Map projections, coordinate systems, geo-referencing, map transformation, Thematic mapping for various applications.		
Module 5	Implementing a GIS and Applications	Hrs. 08
Implementing a GIS: Awareness, developing system requirements, evaluation of alternative systems, decision making using GIS. Applications of GIS: GIS-based road network planning, Mineral mapping using GIS, Shortest path detection using GIS, Hazard Zonation using remote sensing and GIS, GIS for solving multi-criteria problems, GIS for business applications.		

Text Books:	
1	Remote Sensing and GIS by Basudeb Bhatta, Oxford University Press, 2 nd Edition, 2011.
2	Introduction to Geographic Information Systems by Kang-Tsung Chang, McGraw-Hill Education (Indian Edition), 7 th Edition, 2015.
3	Fundamentals of Geographic Information Systems by Michael N. Demers, 4 th Edition, Wiley Publishers, 2012.
4	Textbook of Remote Sensing and Geographical Information Systems by M. Anji Reddy.
Reference Books:	
1	Remote Sensing and Image Interpretation by Thomas M. Lillesand and Ralph W. Kiefer, Wiley Publishers, 7 th Edition, 2015.
2	Geographic Information systems – An Introduction by Tor Bernhardsen, Wiley India Publication, 3 rd Edition, 2010.
3	Advanced Surveying: Total Station, GIS and Remote Sensing by Satheesh Gopi, R. Sathi Kumar, N. Madhu, Pearson Education, 1 st Edition, 2007.

SUBJECT CODE		OPEN ELECTIVE-III						CREDITS
24UD1ARPOEM05O		Ground Improvement Techniques						03
Teaching Work Load/week (Hrs.)				Examination Scheme (Marks)				
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total	
3	0	0	02	20	20	60	100	

Course Objectives	
COBJ1	Understand the Need for Ground Improvement: Recognize the necessity and scope of ground improvement in geotechnical engineering projects.
COBJ2	Explore Dewatering Techniques: Learn various methods for lowering groundwater and their applications in soil stabilization.
COBJ3	Analyze Compaction Methods: Investigate in-situ compaction techniques for both granular and cohesive soils, and assess factors influencing compaction.
COBJ4	Evaluate Drainage and Consolidation Aids: Study the function and design of sand drains, wick drains, and related methods for soil strengthening and settlement reduction.
COBJ5	Understand Reinforcement Techniques: Learn the principles of earth reinforcement, geotextiles, and their practical applications in filtration, drainage, and erosion control.

Course Outcomes: Students will be able to	
CO1	Explain the principles and methods of dewatering and groundwater control in soil stabilization
CO2	Identify and apply various compaction techniques and evaluate their effectiveness for different soil types.
CO3	Design stone columns, lime piles, root piles, and understand soil nailing techniques for slope stability and liquefaction mitigation.
CO4	Apply the principles of reinforced earth design and select appropriate geosynthetics for engineering applications.
CO5	Distinguish between types of grout and grouting methods; design grouting systems for specific geotechnical issues including expansive soil stabilization.

Course Contents

Module 1	Dewatering: Introduction	Hrs. 8
Scope and necessity of ground improvement in Geotechnical engineering basic concepts. Drainage – Ground Water lowering by well points, deep wells, vacuum and electroosmotic methods. Stabilization by thermal and freezing techniques - Applications.		
Module 2	Compaction and Sand Drains	Hrs. 6
Insitu compaction of granular and cohesive soils, Shallow and Deep compaction methods – Sand piles – Concept, design, factors influencing compaction. Blasting and dynamic consolidation – Preloading with sand drains, fabric drains, wick drains etc. – Theories of sand drain – design and relative merits of various methods – Case studies.		
Module 3	Stone Column, Lime Piles and Soil Nailing	Hrs. 5

Stone column, lime piles – Functions – Methods of installation– design, estimation of load carrying capacity and settlement. Root piles and soil nailing – methods of installation – Design and Applications - Soil liquefaction mitigation methods - case studies.		
Module 4	Earth Reinforcement	Hrs. 4
Earth reinforcement – Principles and basic mechanism of reinforced earth, simple design: Synthetic and natural fiber-based Geotextiles and their applications. Filtration, drainage, separation, erosion control – case studies.		
Module 5	Grouting	Hrs. 4
Grouting – Types of grouts – Suspension and solution grouts – Basic requirements of grout. Grouting equipment – injection methods – jet grouting – grout monitoring – Electro – Chemical stabilization – Stabilization with cement, lime - Stabilization of expansive clays – case studies.		

Text Books:	
1	Pappala, A.J., Huang,J., Han, J., and Hoyos, L.R., "Ground Improvement and Geosynthetics; Geotechnical special publication No.207, Geo Institute, ASCE, 2010
2	Cox, B.R., and Griffiths S.C., "Practical Recommendation for Evaluation and mitigation of Soil Liquefaction" in Arkansas, (Project Report), 2010.
3	Day, R.W., "Foundation Engineering Handbook, McGraw – Hill Companies, Inc. 2006.
4	Rowe, R.K., "Geotechnical and Geoenvironmental Engineering Handbook, Kluwer Academic Publishers, 2001.
5	Das, B.M., "Principles of Foundation Engineering, Fourth Edition, PWS Publishing, 1999.
Reference Books:	
1	Moseley, M.P., "Ground Treatment, Blackie Academic and Professionals, 1998.
2	Koerner, R.M., "Designing with Geosynthetics, Third Edition, Prentice Hall 1997.
3	Hehn, R.W., "Practical Guide to Grouting of Underground Structures, ASCE, 1996
4	Jewell, R.A., "Soil Reinforcement with Geotextiles, CIRIA, London, 1996.
5	Koerner, R.M. and Welsh, J.P., "Construction and Geotechnical Engineering using Synthetic Fabrics”

SUBJECT CODE		OPEN ELECTIVE-III				CREDITS	
24UD1ARPOEM05P		Sustainable Construction Methods				03	
Teaching Work Load/week (Hrs.)				Examination Scheme (Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
3	0	0	02	20	20	60	100

Course Objectives	
COBJ1	To introduce the concepts of sustainability in the built environment.
COBJ2	To familiarize students with sustainable and alternative building materials.
COBJ3	To explore eco-friendly and cost-effective construction methods and technologies.
COBJ4	To understand green building standards and regulations.
COBJ5	To introduce digital and smart technologies for sustainable construction.

Course Outcomes: Students will be able to	
CO1	Explain the fundamental concepts of sustainability.
CO2	Describe the properties and uses of sustainable building materials.
CO3	Identify suitable construction techniques and practices for sustainable buildings.
CO4	Discuss the standards and guidelines for sustainable buildings.
CO5	Comment on the role of BIM and automation in sustainable construction.

Course Contents

Module 1	Introduction to Sustainability	Hrs. 8
Impacts of global warming, sustainability indicators - Carbon foot print, Embodied energy and carbon, sustainability analysis - Lifecycle Analysis, EIA - Concept of Green Buildings.		
Module 2	Sustainable building materials	Hrs. 8
Introduction to sustainable building materials, qualities, use, examples - Natural building materials, locally available and locally manufactured materials – wood, earth, stone and lime-based materials. Alternative Building Materials - Overview and definition of alternative or appropriate building materials - Alternative materials developed and promoted by government organisations like CSIR labs: CBRI and SERC, GRIHA, ASTRA (IISc), BMTPC, HUDCO and its building centers - Alternative materials developed and promoted by non-government organisations DA, Auroville, TERI.		
Module 3	Sustainable methods & technologies	Hrs. 5
Eco friendly and low-cost techniques - Different substitute, for wall construction - Flemish Bond - Rat Trap Bond – Arches – Panels - Cavity Wall – Ferro, Cement and Ferro Concrete constructions – different pre cast members using these materials -Alternate roofing systems - Filler Slab - Composite Beam and Panel Roof -Pre-engineered and ready to use building elements - wood products -steel and plastic –Mivan technique -Contributions of agencies - Costford - Nirmithi Kendra – Habitat		
Module 4	Green building rating systems	Hrs. 4

Green building rating systems – Guidelines from IGBC – LEED rating system, TERI-GRIHA rating system. Codes - Energy Conservation Building Code (BEE), National Building Code. Green Building Case studies – Residential, Institutional, and Commercial. Concept of Net Zero buildings – Use of BIPV and other renewable energy in buildings		
Module 5	ICT for Sustainable Construction	Hrs. 4
Building Information modeling – Introduction to BIM, concepts and benefits, BIM for construction scheduling, cost estimation and construction management. Building Automation – Concepts, components of BA, applications of BA for functional efficiency of buildings.		

Text Books:	
1	Sustainable Building - Design Manual Pt 1 & 2, The Energy and Resources Institute, TERI, 2004
2	Automation Systems in Smart and Green Buildings (Modern Building Technology), Er. V K Jain, Khanna Publishers.
3	Jagadish. K.S. Alternative Building Materials and Technologies, New age International Pvt Ltd Publishers, 2008
4	Energy Conservation Building Code of India, User manual, 2007
5	P.K. Singh, Rainwater Harvesting: Low cost indigenous and innovative technologies, Macmillan Publishers India, 2008
Reference Books:	
1	Ross Spiegel.G, Green Building Materials A Guide to Product Selection and Specification,
2	Traci Rose Rider, Stacy Glass, Jessica McNaughton, Understanding Green Building Materials, W.W.Norton and Company, 2011
3	BIM Handbook: A Guide to Building Information Modeling for Owners, Managers, Designers, Engineers and Contractors- Chuck Eastman, et al.
4	Jagadish. K.S. Building with stabilised mud, I.K. International Publishing House Pvt. Limited, 2007

SUBJECT CODE		Engineering Economics and Project Management (Multi-Disciplinary Minor-II)					CREDITS	
25UD1191MD506							3	
Teaching Work Load/week(Hrs.)				Examination Scheme(Marks)				
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total	
3	0	0	03	20	20	60	100	

Course Objectives	
COBJ1	Introduce fundamentals of project management, types of projects, and organizational structures.
COBJ2	Develop skills in project planning, scheduling, and application of tools like CPM, PERT, and WBS.
COBJ3	Familiarize students with resource management, site layout, equipment productivity, and safety practices.
COBJ4	Enable understanding of project monitoring and control techniques including EVM and software applications.
COBJ5	Provide knowledge of engineering economics, financial principles, and project financing methods.

Course Outcomes: On completion of course, students will be able to	
CO1	Describe and explain key concepts of project management including roles, structures.
CO2	Develop and interpret project schedules using tools of construction management
CO3	Plan and manage materials, manpower, equipment, and site layout with attention to productivity and safety.
CO4	Analyze project progress using resource optimization, network analysis, and EVM techniques with basic software applications
CO5	Assess the economic viability of projects using time value of money, investment criteria, and feasibility reporting.

Course Contents

Module 1	Fundamentals of Project Management	Hrs. 08
Project and Project Management Basics, Management: Objectives, Functions, Principles, Project Types: Infrastructure, Industrial, R&D, Turnkey, Causes of Project Failure, Project Life Cycle and Cost Components, PMBOK: Domains and Knowledge Areas, Role of PMI and PMP Certification, Organizational Structures: Functional, Matrix, Projectized, Management by Objectives (MBO)		
Module 2	Project Planning and Scheduling	Hrs. 08
Planning: Strategic, Tactical, Operational, Work Breakdown Structure (WBS), Gantt/Bar Chart – Uses and Limitations, Network Techniques – Terms and Concepts, Critical Path Method (CPM – AOA), Floats and Critical Activities, Precedence Diagramming (AON), Types of Precedence Relationships, PERT – Time Estimation with Variability		
Module 3	Project Resources and Site Management	Hrs. 08
Material Management Objectives, Procurement Cycle: Indenting to Delivery, Excel and ERP for Material Tracking,		

Inventory Control: ABC Analysis, EOQ, Equipment Management: Productivity, Downtime, Fleet and Equipment Planning, Site Layout Planning Factors, Safety Norms – PPE, Legal Requirements		
Module 4	Project Monitoring and Control	Hrs. 06
Resource Allocation: Smoothing and Levelling, Network Crashing – Time-Cost Trade-off, Resource Optimization, Monitoring Progress and Milestones, Network Updating: Delays and Rescheduling, Earned Value Management (EVM), Software Introduction: MS Project / Primavera		
Module 5	Engineering Economics and Financial Principles	Hrs. 08
Role of Economics in Civil Projects, Economic Terms: Cost, Value, Price, Profit, Time Value of Money – PW, FW, Annuities, Interest Calculations: Simple and Compound, Demand & Supply – Concepts and Laws, Economic Laws: Demand, Substitution, Utility, Capital Types: Fixed, Working, Project Finance Sources: Debt vs Equity, Capital Instruments: Equity, Debentures, FDI		

Text Books:	
1	Construction Project Management-Planning, Scheduling and Controlling by K. K. Chitkara, TMH.
2	Construction Management and Planning by B. Sengupta and H. Guha, Tata McGraw Hill .
3	The Essentials of Project Management by Dennis Lock, Gower Publishing Ltd. UK.
4	Total Engineering Quality Management – Sunil Sharma Macmillan India Ltd.
Reference Books:	
1	R. Panneerselvam – <i>Engineering Economics</i>
2	Total Quality Management - Dr. S.Rajaram and Dr. M. Sivakumar-- Biztantra

SUBJECT CODE		Design of Steel Structures Lab				CREDITS	
25UD1191PCL507						1	
Teaching Work Load/week (Hrs.)				Examination Scheme (Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
0	0	2	2	50	-	50	100

Course Outcomes: On completion of course, students will be able to	
CO1	Illustrate the geometric and dimensional characteristics of various structural steel sections, types of trusses, and types of structural connections through detailed engineering drawings.
CO2	Analyze and design industrial shed structures using portal or gable frame systems with appropriate bracing, purlins, columns, and base plates, considering practical loading conditions.
CO3	Evaluate the structural behavior of trussed roof systems with bracing and perform detailed design of purlins, columns, and column bases for industrial applications.
CO4	Design gantry girders along with supporting columns, bracings, and associated structural elements for industrial sheds subjected to moving loads from cranes.
CO5	Analyze and design structural systems involving composite steel–RCC construction with emphasis on load-sharing behavior, member design, and detailing.

Course Contents

Term work shall consist of detailed analytical report for structural design and drawing of any one of the following steel structures from Group A and B. Student may use IS 800-1984 or 2007.

Group A
1) Drawing of structural steel sections, types of trusses, types of connections, 2) Industrial Shed: With Portal or Gable Frames of Solid or Open Web Sections with Necessary Bracing System, Purlins, Column and Column Bases 3) Analysis and design of any structural steel building.
Group B
1) Industrial Shed: Roof Truss with Necessary Bracing System, Purlins, Column and Column Bases 2) Industrial Shed: Gantry Girder, Columns with Necessary Bracing System, Purlins, Column and Column Bases 3) Analysis and design of structural steel -RCC composite building.

SUBJECT CODE		OCF & HM Lab				CREDITS	
25UD1191PCL508						1	
Teaching Work Load/week (Hrs.)				Examination Scheme (Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
0	0	2	2	25	-	25	50

Course Outcomes: On completion of course, students will be able to	
CO1	Calculate coefficient of discharge for flow measuring equipment in open channels and closed conduits.
CO2	Study mechanism of hydraulic jump.
CO3	Understand mechanism of pumps and turbines.
CO4	Understand the impact of jets on various surfaces.
CO5	Evaluate the performance characteristics of Pelton, Kaplan, and Francis turbines

Course Contents

Practical Work consists of at least six performances from list below and detailed reporting in form of journal.

Experiment No 1	Calibration of V notch / Rectangular notch.
Experiment No 2	Calibration of Ogee Weir.
Experiment No 3	Velocity distribution in open channel in transverse direction of flow.
Experiment No 4	Study of hydraulic jump
Experiment No 5	Impact of jet
Experiment No 6	Study of Turbines
Experiment No 7	Tests on Centrifugal Pump
Experiment No 8	Performance Characteristics of Pelton/ Kaplan/ Francis Turbine
Use of computer programs such as MS Excel is desirable for post-processing of results.	

SUBJECT CODE		<h1>Geotechnical Engineering Lab</h1>				CREDITS	
25UD1191PCL509						1	
2 hours / week				Examination Scheme (Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
0	0	2	2	25	-	25	50

Course Outcomes: On completion of course, students will be able to	
CO1	Determine basic physical properties of soils for classification.
CO2	Evaluate soil compaction characteristics using Proctor tests.
CO3	Measure in-situ density and bearing capacity of soils.
CO4	Assess soil permeability and consolidation for drainage and settlement.
CO5	Analyze soil shear strength parameters for stability analysis.

Course Contents

Practical Work consists of at least eight performances from list below and detailed reporting in form of journal.

Experiment No 1	To find out specific gravity of soil solids by Pycnometer Method
Experiment No 2	Determination of moisture content by oven drying method
Experiment No 3	To detect field density of the soil by core cutter method
Experiment No 4	To ensure grain size distribution by mechanical sieve analysis.
Experiment No 5	To work out Atterberg's limits (LL, PL and SL)
Experiment No 6	To determine compaction properties by Standard Proctor Test
Experiment No 7	To figure out of permeability of soil by using falling head test
Experiment No 8	To decide shear strength parameters by direct shear test.
Experiment No 9	To find out shear strength by unconfined compressive strength test.
Experiment No 10	To determine of shear strength parameters by Triaxial shear test.
Experiment No 11	Determination of C.B.R. value by conducting laboratory CBR test. (soaked/unsaturated)
Experiment No 12	To decide Coefficient of consolidation by conducting consolidation test
Experiment No 13	To work out Compaction properties of soil by modified proctor test
Experiment No 14	To determine permeability of soil by using constant head method
Experiment No 15	To analyze the stability of an earth slope using GEO5's Slope Stability module, determine the Factor of Safety (FOS) using Bishop's Simplified Method, and study the influence of soil shear strength parameters (cohesion c and angle of internal friction ϕ) on slope stability.
Use of computer programs such as MS Excel is desirable for post-processing of results.	

SUBJECT CODE		Soft Skills Development						CREDITS
25UD1191HM510								AU
Teaching Work Load/week(Hrs.)				Examination Scheme(Marks)				
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total	
0	2	0	02	-	-	-	GR	

Course Objectives	
COBJ1	To inculcate soft skills so that students can work efficiently in the corporate sector and government organisations.
COBJ2	To provide knowledge of conflict management while working in large organisations
COBJ3	To develop management skills required in routine work environment
COBJ4	To polish the personality of the learners in order to make them good leaders and employees
COBJ5	To imbibe qualities like manners and etiquettes, coordination, mutual understanding for their colleagues while working in a group.

Course Outcomes: On completion of course, students will be able to	
CO1	Learners will acquire interpersonal communication skills
CO2	Learners will develop the ability to work independently
CO3	Learners will develop the qualities like self-discipline, self-criticism and self-management
CO4	Learners will have the qualities of time management and discipline
CO5	Learners would be able to present themselves as an inspiration for others

Course Contents

Module 1	Introduction to Soft Skills and Personality Development	Hrs. 08
Introduction to Soft Skills, Need of Soft Skills, New Approach to Learning, Human Perceptions: Understanding People, Types of Soft Skills: Self-Management Skills, Interpersonal Skills, What is Personality, Personality Development.		
Module 2	Self-Management & Self-Management Techniques	Hrs. 08
Self Management, Stress Management: Types of Stress: Self-Awareness about Stress, Regulating Stress: Making The Best out of Stress, Self-Evaluation, Self- discipline, Self-criticism, Recognition of one's own limits and deficiencies, dependency, etc. - Self-Awareness, Self-Management, identifying one's strengths and weaknesses, Planning & Goal setting, Managing self-emotions, ego, pride		
Module 3	Interpersonal Skills Development	Hrs. 05
Positive Relationship, Positive Attitudes, Empathise: comprehending others' opinions, points of views, and face them with understanding, Mutuality, Trust, Emotional Bonding, Handling Situations (Interview), Importance of interpersonal skills, Creative Thinking, Critical Thinking.		
Module 4	Problem Solving Techniques	Hrs. 05
Conflict Resolution Skills: Seeking Win-Win Solution (Negotiation Skills), Inter-Personal Conflicts: Two Examples, Inter-Personal Conflicts: Two Solutions, Types of Conflicts: Becoming a Conflict		

Resolution Expert		
Module 5	Motivation/ Inspiration and Motivation Techniques	Hrs. 05
Ability to shape and direct working methods according to self-defined criteria, Ability to think for oneself, apply oneself to a task independently with self-motivation, Motivation techniques based on needs and field situations, Leadership and Team Dynamics.		

Text Books:	
1	Mitra, Barun. Personality Development and Soft Skills. Oxford University Press, 2016.
2	Ramesh, Gopalswamy. The Ace of Soft Skills: Attitude, Communication and Etiquette for Success. Pearson Education, 2013.
3	Covey, Stephen R. Seven Habits of Highly Effective People: Powerful Lessons in Personal Change. Simon & Schuster Ltd., 2013.
4	Rosenberg, Marshall B. Nonviolent Communication: A Language of Life. Puddle Dancer Press, 2015.

SUBJECT CODE		Construction Equipment and Site Safety Management				CREDITS	
25UD1191VS511						3	
Teaching Work Load/week (Hrs.)				Examination Scheme (Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
3	0	0	03	20	20	60	100

Course Objectives	
1	To provide foundational knowledge on the types, selection criteria, economic evaluation (including ownership and operating costs), and life-cycle planning of construction machinery, along with an introduction to automation trends in the industry.
2	To familiarize students with various earthmoving and material handling machines used in construction, their specific applications in foundational work, and the importance of regular safety inspections and operational protocols.
3	To introduce the machinery and techniques involved in road construction and concrete operations, with a focus on modern technologies and practical deployment strategies through real-world case studies.
4	To impart knowledge of essential safety practices on construction sites, identify major hazards, and promote awareness of safety measures, layout planning, PPE usage, and emergency preparedness.
5	To develop an understanding of construction safety legislation, standards (e.g., OSHA, ISO 45001), risk analysis tools, and structured safety management systems to ensure legal compliance and promote a culture of proactive safety.

Course Outcomes: On completion of course, students will be able to	
CO1	Students will be able to identify, classify, and evaluate construction equipment based on project suitability, cost-effectiveness, and operational productivity, and perform ownership and operating cost analysis including equipment depreciation and replacement planning.
CO2	Students will be able to explain the working principles and applications of various earthmoving and material handling equipment and demonstrate an understanding of safety requirements and

	inspection protocols in field operations.
CO3	Students will be able to select and apply appropriate equipment for road construction and concreting tasks, analyze construction case studies, and evaluate modern concreting techniques and technologies such as shotcreting and slip-forming.
CO4	Students will be able to assess construction site hazards, apply standard safety practices and preventive measures, and plan for site layout and emergency preparedness to mitigate risks effectively.
CO5	Students will be able to interpret and apply construction safety regulations, conduct risk assessments and safety audits, and implement effective Safety Management Systems aligned with international standards.

Course Contents

Module 1	Introduction to Construction Equipment	Hrs. 08
<p>The classification of construction equipment, the fundamental criteria for selecting appropriate machinery based on productivity, cost-effectiveness, project suitability, The estimation of ownership and operating costs, understanding equipment depreciation, replacement policies, introduction to automation trends in construction equipment.</p>		
Module 2	Earthmoving and Material Handling Equipment	Hrs. 08
<p>Types of earthmoving machinery such as excavators, bulldozers, backhoe loaders, and scrapers, along with compacting equipment like rollers and rammers, material handling tools including different types of cranes, hoists, conveyors, forklifts. Emphasis is placed on equipment used for foundation works, the importance of safety protocols and inspection routines for all these machines.</p>		
Module 3	Road Construction and Concreting Equipment	Hrs. 08
<p>The equipment used in road construction including pavers, graders, and milling machines. Equipment for concrete-related operations such as batching plants, transit mixers, concrete pumps, and slip-forming machines, advanced techniques such as shotcreting, the use of asphalt mixing and laying equipment, practical case studies to illustrate the effective deployment of such equipment in real-world projects.</p>		
Module 4	Construction Site Safety Management	Hrs. 08
<p>The concept of construction safety, common hazards, and accident trends in the industry, safety measures such as proper signage, the use of personal protective equipment (PPE), the role of site layout in enhancing safety, risks associated with working at heights, excavation, trenching, fire hazards, and electrical safety, emergency planning and basic first aid procedures.</p>		
Module 5	Safety Laws, Regulations, and Management Systems	Hrs. 08
<p>The legal and regulatory framework governing construction safety, relevant national standards and international benchmarks such as OSHA and ISO 45001. Statutory compliance, conducting safety audits and inspections, preparation of safety reports, risk assessment methods, job hazard analysis (JHA), the implementation of comprehensive Safety Management Systems (SMS), behavior-based safety approaches.</p>		

Text Books:	
1	Sharma, S.C., Construction Equipment and Management, Khanna Publishers.
2	Hinze, J., Construction Safety, Prentice Hall.
3	Peurifoy, R.L., Construction Planning, Equipment, and Methods, McGraw-Hill.
4	Goetsch, D.L., Construction Safety and Health, Pearson
5	Mahesh Varma, Construction Equipment and Its Planning and Application, Metropolitan Book Co. Pvt. Ltd.
Reference Books:	
1	IS Codes and OSHA Construction Safety Manuals.
2	CPWD Safety Code and Manuals.

Dr. Babasaheb Ambedkar Technological University, Lonere
Teaching & Evaluation Scheme for Third Year B. Tech. Civil Engineering

Sr. No.	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credits
			L	T	P	ISE	MSE	ESE	Total	
Semester-VI										
1	25UD1191PC601	Design of Concrete Structures	3	0	0	20	20	60	100	3
2	25UD1191PE602	Program Elective-I	3	0	0	20	20	60	100	3
3	25UD1191PE603	Program Elective -II	3	0	0	20	20	60	100	3
4	25UD1191PE604	Program Elective-III	3	0	0	20	20	60	100	3
5	25UD1191PC 605	Foundation Engineering	3	0	0	20	20	60	100	3
6	Refer Bucket	Multi-Disciplinary Minor-III (From Bucket)	3	0	0	20	20	60	100	3
7	25UD1191PCL607	Concrete Structures Lab	0	0	2	50	-	50	100	1
8	25UD1191PEL608	Program Elective-II- Lab	0	0	2	25	-	25	50	1
9	25UD1191PEL609	Program Elective-III- Lab	0	0	2	25	-	25	50	1
10	25UD1191EL610	Seminar	0	0	2	25	-	25	50	1
11	25UD1191VS611	Academic Research Writing	1	0	0	25	-	25	50	1
12	25UD1191EL612	Project Phase-I	0	0	4	50	-	50	100	2
TOTAL			19	0	12	320	120	560	1000	25

Course Type	Course Code	Course Name	Course Type	Course Code	Course Name
Program Elective-I	25UD1191PE602A	Hydraulics Structures	Open elective-III	24UD1ARPOEM05H	Geomatics Engineering
	25UD1191PE602B	Irrigation Engineering		24UD1ARPOEM05O	Ground Improvement Techniques
Program Elective-II	25UD1191PE603A	Water Quality Engineering		24UD1ARPOEM05P	Sustainable Construction Methods
	25UD1191PE603B	Environment Health and Safety	Multi-Disciplinary Minor-II	Refer Bucket	Refer Bucket
Program Elective-III	25UD1191PE604A	Highway & Railway Engineering	Multi-Disciplinary Minor-III	Refer Bucket	Refer Bucket
	25UD1191PE604B	Intelligent Transportation Systems			
	25UD1191PE604C	Traffic Engineering & Management			

SUBJECT CODE		<h1>Design of Concrete Structures</h1>						CREDITS	
25UD1191PC601								3	
Teaching Work Load/week (Hrs.)				Examination Scheme (Marks)					
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total		
3	0	0	03	20	20	60	100		

Pre-requisite: Engineering Mechanics, Mechanics of Solids, Structural Mechanics

Course Objectives	
COBJ1	Understand principles and philosophies of reinforced concrete design.
COBJ2	Apply IS:456-2000 and other relevant codes in structural design.
COBJ3	Design structural members using both Working Stress and Limit State Methods.
COBJ4	Evaluate safety, serviceability, and detailing requirements for RCC structures.

Course Outcomes: On completion of course, students will be able to	
CO1	Explain (Understand) the design philosophies, stress-strain behavior, and code provisions.
CO2	Analyze (Analyze) structural behavior of beams, slabs, columns, and footings.
CO3	Design (Create) RCC elements under different loading and support conditions.
CO4	Evaluate (Evaluate) structural safety and detailing in accordance with IS code.
CO5	Apply (Apply) theoretical and practical knowledge in preparing detailed RCC designs.

Course Contents

Module 1	Fundamentals and Working Stress Method	Hrs. 08
Basic aspects of structural design, design philosophies (WSM, ULM, LSM), Stress-strain behavior of concrete and steel, Comparison of WSM, ULM, and LSM, factor of safety, load estimation, Introduction to Working Stress Method, permissible stresses, assumptions, Basic design of RC sections using WSM principles.		
Module 2	Structural Design Using WSM	Hrs. 08
Stress block parameters and section classification (under/over-reinforced, balanced), Flexural design of singly and doubly reinforced beams using WSM, Shear design principles and detailing of reinforcement, Design of axially and uniaxially loaded short columns, Design of isolated column footings, WSM as per IS:456-2000 Annexure B.		
Module 3	Limit State Method - Philosophy, Shear, and Bond	Hrs. 08
Limit State approach: definition, types, and classifications of limit states, Characteristic loads and strengths, partial safety factors, Strain variation and stress distribution diagrams, serviceability requirements, Design for shear: types of shear failure, reinforcement types, minimum shear steel, Design for bond: development length, anchorage, detailing as per IS code.		
Module 4	Limit State Design in Flexure - Beams, Slabs, and Staircases	Hrs. 08
Design of singly and doubly reinforced beams using LSM, Design of flanged beams (L and T sections), Design and detailing of one-way and two-way slabs under various loading/supports, Deflection and crack control criteria, Design of staircases: dog-legged and open-well, effective span, and load distribution.		

Module 5	Compression Members and Footings - Limit State Design	Hrs. 08
<p>Design of axially and eccentrically loaded short columns (rectangular and circular), Construction of interaction diagrams for uni-axial bending, Concept of bi-axial bending and interaction surface (theoretical introduction), Design and detailing of isolated footings for axial and uniaxial loads, Practical considerations in reinforcement layout and anchorage.</p>		

Text Books:	
1	Varghese, P. C. Limit State Design of Reinforced Concrete, PHI Learning.
2	Pillai, S. U., & Menon, D. Reinforced Concrete Design, McGraw-Hill.
3	Jain, A. K. Limit State Design of RCC, Nem Chand & Bros.
4	Subramanian, N. Design of Reinforced Concrete Structures, Oxford University Press.
5	Punmia, B. C. Reinforced Concrete Structures, Laxmi Publications.
Reference Books:	
1	IS:456-2000 – Code of Practice for Plain and Reinforced Concrete, BIS.
2	Handoo, B. L. Concrete Structures, Satya Prakashan.

SUBJECT CODE		PROGRAM ELECTIVE-I				CREDITS	
25UD1191PE602A		Hydraulic Structures				3	
Teaching Work Load/week (3 Hrs.)				Examination Scheme (100 Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
3	0	0	03	20	20	60	100

Pre-requisite: Knowledge of Applied Mechanics, Fluid Mechanics and Irrigation Engineering.

Course Objectives	
COBJ1	Understand the theoretical and design principles of key hydraulic structures.
COBJ2	Analyze the stability, hydraulic efficiency, and structural safety of these structures.
COBJ3	Apply national standards and modern tools for hydraulic structure design.
COBJ4	Evaluate the environmental impact and safety issues of hydraulic projects.

Course Outcomes: On completion of course, students will be able to	
CO1	Classify and describe various hydraulic structures and their functional requirements.
CO2	Analyze and design gravity and earth dams considering stability and seepage.
CO3	Design spillways and energy dissipators in accordance with IS standards.
CO4	Evaluate and design canal structures, diversion headworks, and cross-drainage works.
CO5	Use hydraulic software tools for modeling and assess environmental and safety concerns in hydraulic projects.

Course Contents

Module 1	Fundamentals of Hydraulic Structures	Hrs. 08
<p>Introduction and classification of hydraulic structures, Site selection and design parameters, Factors governing selection of type of dam, Classification of dams, Classification based on purpose, Classification based on materials, Classification based on size of project, Classification based on hydraulic action, Classification based on structural action, Dams and earthquakes, Dams and social issues, Large dams verses small dams, Displacement and rehabilitation, Dams and climate change ,Overview of hydrological and geological considerations, Introduction to IS code practices.</p>		
Module 2	Dams and Reservoirs	Hrs. 08
<p>Types and classification of dams: Gravity, Arch, Earth-fill, Rock-fill, Design of gravity dams: Stability, stress analysis, practical profiles, Seepage and slope stability in earth dams, Reservoir planning, sedimentation, and control. Introduction, Function of diversion headworks, Selection of site for diversion headworks, Layout of diversion headworks, Components of diversion headworks, Design of weir on permeable foundation,</p>		
Module 3	Spillways and Energy Dissipators	Hrs. 08
<p>Different key levels and heads in spillway, Spillway Capacity, Components of spillway, Approach channel Control structure, Discharge channel. Classification based on operation, Main or service spillway, Auxiliary spillway, Emergency spillway, Classification based on gates, Gated spillway, Ungated spillway, Classification based on features, Straight drop spillway (Free overflow spillway), Saddle spillway, Side channel spillway, Types and functions of spillways: Ogee, chute, shaft, siphon, Conduit, Stepped</p> <p>Design of ogee spillways and related hydraulics, Energy dissipation device, Energy dissipation: Hydraulic jumps, stilling basins, bucket-type energy dissipators. IS Design standards (IS: 4997, 6934)</p>		
Module 4	Canal and River Structures	Hrs. 08
<p>Design of weirs and barrages on permeable foundations, Canal falls: Sarda, trapezoidal notch, and their design, Cross-drainage works: aqueduct, siphon aqueduct, super passage, Diversion headworks: layout and sediment control devices</p> <p>Introduction, Classification of canals, Classification based on alignment, Classification based on soil, Classification based on source of supply, Classification based on discharge, Classification based on lining, Classification based on excavation, Components of canal , Data required for canal design, Selection of canal alignment, Design of stable canal in alluvial beds, Kennedy's theory, Design of canal by Kennedy's theory, Limitations of Kennedy's theory, Lacey's regime theory, Design of canal by Lacey's theory, Canal lining, Need of canal lining, Requirements of lining material, Classification of canal lining, Hard surface lining including Ferrocement lining, Soft surface lining, Burried lining, Advantages of canal lining, Design of lined canal, Benefit – cost analysis for canal lining.</p> <p>Canal Structures Canal falls Introduction, Necessity of canal fall, Selection of site for canal fall, Classification of canal fall, Types of falls, Free fall or open fall, Notch fall, Ogee Fall, Rapid Stepped fall, Straight glacis fall, Sarda</p>		

fall, Semi pressure fall, Baffle or Englis Fall, Montague fall Siphon well or cylinder fall, Pressure or closed conduit fall, Shaft or Pipe fall, Selection of type of fall, Canal outlets- Introduction of Canal outlet or module, Canal escapes- Introduction of Escapes, Significance of canal escape, Canal regulators--Canal regulators,		
Module 5	Advanced Topics and Safety	Hrs. 08
<p>Introduction, Necessity of cross drainage works, Selection of site for Cross Drainage work, Data required for design of Cross Drainage work, Classification of Cross Drainage works, Drain over canal-Siphon, Super passage, Canal over drain—Aqueduct, Siphon aqueduct, Canal and drain water mixed in each other--Level crossing, Inlet and Outlet, Selection of suitable type of C. D. works, Design considerations for cross drainage works.</p> <p>River Training Structures- Classification of rivers, Classification based on topography, regime, alignment, source, Behaviour of rivers, River training, Objectives of river training, Classification of river training, purpose, orientation, River training structures, Embankment or Levee, Guide banks, Groynes or spurs, Artificial cut off, Pitched Island, submerged sill or dykes, Closing dykes.</p> <p>Introduction to hydraulic modeling and simulation tools (e.g., HEC-RAS, auto cad, civil 3D), Environmental impact assessment of large hydraulic projects, Dam safety, monitoring, rehabilitation, and case studies of dam failures.</p>		

Text Books:	
1	Arora, K.R., “Irrigation, Water Power and Water Resources Engineering”, Standard Publishers Distributors, Delhi.
2	Modi, P.N.,” Introduction to Water Resources and Waterpower Engineering”, Standard Publication, Delhi
3	Garg, S.K., “Irrigation Engineering and Hydraulic Structures” Khanna Publishers
4	Asawa, G, L “Irrigation and Water Resources Engineering”, New Age Int. Ltd.
5	“Hydraulic Engineering”, J. A. Roberson, J. J. Cassidy, M. N. Chaudhry, John Wiley & Sons, New York, 1998.
Reference Books:	
1	Water Resources Engineering by R.K. Linsley & J.L.H. Paulhus, McGraw Hill.
2	Open channel hydraulics by Ven Te Chow Mc Graw Hill Book Co. International Students Edition

SUBJECT CODE	PROGRAM ELECTIVE-I						CREDITS
25UD1191PE602B	Irrigation Engineering						3
Teaching Work Load/week (Hrs.)				Examination Scheme (Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
3	0	0	3	20	20	60	100

Course Objectives:	
COBJ1	To introduce fundamental concepts of hydrology and importance of irrigation engineering
COBJ2	To provide knowledge on reservoir and dam engineering,
COBJ3	To familiarize students with canal systems and structures
COBJ4	To understand lift irrigation and well irrigation systems
COBJ5	To introduce problems of water logging and drainage

Course Outcomes: Students will be able to	
CO1	Understand and apply basic hydrologic principles and estimate water requirements of crops and irrigation methods based on soil and crop characteristics.
CO2	Classify and plan reservoir and dam systems, and evaluate their components and storage capacities.
CO3	Explain spillways, canal alignments, canal structures, and apply Khosla's and Bligh's seepage theories.
CO4	Evaluate the design principles and types of lift irrigation and well irrigation systems.
CO5	Identify causes of water logging and suggest suitable drainage and water conservation measures.

Course Contents

Module 1	Introduction Hydrology & Irrigation	Hrs. 8
<p>Hydrology, measurement of rainfall, peak flow, base flow, precipitation and its measurement, average depth of precipitation, water losses, flood frequency, catchment area formulae, flood hydrograph, rainfall analysis, infiltration, run off, estimation of runoff, unit hydrograph and its determination, s- hydrograph</p> <p>Introduction, definition, scope, necessity, ill-effects of irrigation, advantages, types of irrigation systems, difference between weir, barrage and dam, methods of distribution of water, development of irrigation in India</p> <p>Introduction to hydrology: hydrologic cycle, rain, surface and ground water.</p> <p>Water Requirement of Crops</p> <p>Water requirement of crops, base, delta and duty, methods of improving duty, types of soil, types of soil water, soil moisture, consumptive use, irrigation frequency, irrigation methods, crops season, crop pattern</p>		
Module 2	Reservoirs and Dams	Hrs. 8
<p>Planning of Reservoirs: Classification of Reservoir, Selection of site for Reservoir, Investigation works for Reservoir, Yield and Capacity of Reservoir, Mass Curve and Demand Curve, Storage Calculations, Control</p>		

Levels, Useful Life of Reservoir, Silting of Reservoirs, Losses in Reservoirs		
Gravity Dams – Estimation of Loading, Design Criteria, Causes of Failure of Gravity Dam, Precaution against Failure, Theoretical and Practical Profile, Stability Calculations, Galleries, Joints, and Earth Dams: Components and their Functions, Design Criterion, Inverted Filters, Downstream Drainage, Causes of Failure of Earthen Dam. Arch Dams – Types, Forces on Arch Dam,		
Module 3	Spillway Weirs and Canals	Hrs. 6
Spillway, Necessity and Different Types, Location of Spill Ways, Selection Criterion, Gates for Spillways, Weirs on Permeable Foundations: Theories of Seepage, Bligh’s Creep Theory, Limitations of Bligh’s Creep Theory, Khosla’s Theory, Piping and Undercutting Canals: Types, Alignment, Kennedy’s and Lacey’s Silt Theories, Canal Losses, Typical Canal Sections, Canal Lining: Necessity and Types, Canal Structures: Cross Drainage Works and Canal Regulatory Works		
Module 4	Lift Irrigation	Hrs. 8
Lift irrigation, wells and tube wells, introduction, classification of well, specific yield, deep and shallow wells, comparative advantage of well and canal irrigation, duty of well water, types of tube wells, types of strainers, boring methods. Darcy’s law, permeability, safe yield of basin. Lift irrigation schemes: Various components and their design principles (Only concepts).		
Module 5	Water logging and drainage	Hrs. 8
Causes of water logging, preventive and curative measures, drainage of irrigation of lands, reclamation of water logged, alkaline and saline lands, Preventive and Curative Measures		
Water Conservation: Rain water Harvesting, Ground Water Recharge, small scale techniques of surface water detention such as: Soil embankments, field ponds		

Text Books:	
1	Varshney R. S., Gupta & Gupta, 1987, “Theory and Design of Irrigation Structures”, Vol. I & II 2.
2	Punamia B. C. Pandey B. B. and Lal, 1992, “Irrigation and Water Power Engineering”, Standard Publishers
3	Garg S. K., 1976, “Irrigation Engineering & Hydraulic Structures”, Khanna Publishers, N. Delhi
4	Priyani, 1982, “Irrigation and Water Power”, Charotar Publishing House, Anand
5	Bharat Singh, 1979, “Irrigation”, Nemchand Brothers, Roorkee
Reference Books:	
1	Subramanya K., 1984, “Engineering Hydrology”, Tata Mc-Graw Hill Company Limited, N. Delhi
2	Drip and Sprinkler Irrigation, R. K. Biswas, New India Publishing Agency, New Delhi.
3	Land Drainage, Battacharaya A. K. & Michael A. M., Vikas Publ.

4	Irrigation Engineering, H. M. Raghunath, Wiley India.
5	Guidelines for Planning and Design of Piped Irrigation Network, Central Water Commission, Ministry of Water Resources, River Development & Ganga Rejuvenation, Govt. of India, New Delhi.

SUBJECT CODE		Program Elective -II Water Quality Engineering						CREDITS	
25UD1191PE603A								3	
Teaching Workload/week (Hrs.)				Examination Scheme (Marks)					
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total		
3	0	0	03	20	20	60	100		

Course Objectives	
COBJ1	To understand the fundamental concepts of water pollution.
COBJ2	To analyze and interpret various water quality parameters.
COBJ3	To design and evaluate water and wastewater treatment processes.
COBJ4	To apply water quality indices and modeling tools.

Course Outcomes: On completion of course, students will be able to	
CO1	Identify and classify different sources of water pollutants and explain the chemical and biological processes affecting water quality.
CO2	Perform laboratory analysis of key water quality parameters and interpret results using appropriate instrumentation and techniques.
CO3	Compare Indian and international water quality standards and assess the suitability of water for drinking, agricultural, industrial, and aquatic uses.
CO4	Design basic components of water treatment plants and evaluate the performance of conventional and advanced treatment systems.
CO5	Analyze the impact of pollution on surface and groundwater bodies.

Course Contents

Module 1	Fundamentals of Water Quality and Pollution	Hrs. 08
Terminology related to water quality and pollution, Sources of water pollutants, Natural and anthropogenic pollution, Pollution kinetics including zero-order, first-order and second-order reactions, Reaction mechanisms in aquatic environments, International water quality standards (WHO), Indian water quality standards (IS 10500) for drinking, irrigation, industrial and aquatic use.		
Module 2	Water Quality Analysis and Instrumentation	Hrs. 08
Water quality parameters including pH, TDS, BOD, COD, DO, turbidity, alkalinity, hardness, nitrates, metals, Analytical methods such as titrimetric, gravimetric, spectrophotometric, electrometric, Instruments used in analysis including pH meter, turbidity meter, DO meter, spectrophotometer, flame photometer, Working		

principles and applications of each instrument		
Module 3	Water and Wastewater Treatment Technologies	Hrs. 08
Water purification methods including mechanical filters, biological filters and membrane filters, Reverse osmosis principle and applications, RO membranes and related instruments, Water treatment processes such as aeration, nitrogen removal, pH control, removal of solids and gases, Disinfection methods using chlorine, bromine, iodine, potassium permanganate, Ion exchange process		
Module 4	Water and Wastewater Treatment Systems	Hrs. 06
Components of water treatment plants, Design and working principles of treatment units, Wastewater treatment methods including primary, secondary and tertiary treatments, Activated sludge process, Trickling filters, UASB reactor, Membrane bioreactor (MBR), Instrumentation in wastewater treatment, Sludge management and disposal techniques.		
Module 5	Water Quality Index, Pollution Impacts and Modeling.	Hrs. 06
Water Quality Index (WQI) concept and principles, Parameters used in WQI calculation, Indian and international WQI standards, Water pollution due to pesticides and toxic metals, Sources and control of arsenic, lead, cadmium and mercury, Water quality modeling concepts, Introduction to QUAL2K and WASP models, Model inputs, calibration and result interpretation.		

Text Books:	
1	Groundwater Hydrology by David Keith Todd- John Wiley & Sons.
2	Water quality assessments by Chapman- D.- (Ed.)- 2nd Ed.- E&FNSPON (Imprint of Chapman & Hall-USA)-Pub. on behalf of UNESCO- WHO- UNEP- 1992.
3	Metcalf & Eddy (Wastewater Engineering: Treatment and Resource Recovery McGraw-Hill Education
4	Water Supply Engineering. By Dr. B.C. Punmia, Ashok Kr. Jain, Arun Kr. Jain
5	Surface Water-Quality Modeling - Steven C. Chapra
Reference Books:	
1	Water Supply Engineering By SK Garg.
2	Environmental Pollution Control Engineering - C. S. Rao

SUBJECT CODE		Program Elective -II Environment Health and Safety						CREDITS	
25UD1191PE603B								3	
Teaching Workload/week (Hrs.)				Examination Scheme (Marks)					
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total		
3	0	0	03	20	20	60	100		

Course Objectives	
COBJ1	To introduce the necessity and framework of Environment, Health, and Safety (EHS) systems.
COBJ2	To impart knowledge of occupational health and hygiene.
COBJ3	To develop understanding of workplace safety systems.
COBJ4	To equip students with risk assessment and hazard control skills.
COBJ5	To familiarize learners with Environmental Health and Safety Management Systems.

Course Outcomes: On completion of course, students will be able to	
CO1	Need for EHS in industries and related Indian regulations.
CO2	Various types of Health hazards, effect, assessment and control methods.
CO3	Various safety systems in working environments.
CO4	The methodology for preparation of Emergency Plans and Accident investigation.
CO5	EHS Management System and its elements

Course Contents

Module 1	Introduction	Hrs. 06
Need for developing Environment, Health and Safety systems in work places- International initiatives, National Policy and Legislations on EHS in India – Regulations and Codes of Practice -Role of trade union safety representatives – Ergonomics.		
Module 2	Occupational Health & Hygiene	Hrs. 08
Definition of occupational health and hygiene – Categories of health hazards – Exposure pathways and human responses–Exposure Assessment-occupational exposure limits Hierarchy of control measures – Role of personal protective equipment and the selection criteria.		
Module 3	Workplace Safety & Safety Systems	Hrs. 08
Features of Satisfactory and Safe design of work premises – good housekeeping – lighting and color, Ventilation and Heat Control, Noise, Chemical and Radiation Safety – Electrical Safety – Fire Safety – Safety at Construction sites, ETP – Machine guarding – Process Safety, Working at different levels.		
Module 4	Hazards & Risk Management	Hrs. 06

Safety appraisal – Job Safety Analysis-Control techniques – plant safety inspection – Accident investigation – Analysis and Reporting – Hazard and Risk Management Techniques –Onsite and Offsite emergency Plans. Employee Participation- Education and Training- Case Studies.		
Module 5	Environmental Health & Safety Management	Hrs. 06
Concept of Environmental Health and Safety Management – Elements of Environmental Health and Safety Management Policy and implementation and review – ISO 45001-Strucure and Clauses-Case Studies.		

Text Books:	
1	The Beginner's Guide to the Environmental, Health and Safety Profession, Chance Roberts.
2	Environmental Safety and Health Regulations, Joel M. Haight, Feb 4, 2013.
3	Safety, Health and Environmental Auditing, Simon Watson Pain, May 31, 2023.
4	Industrial Health and Safety Acts and Amendments, by Ministry of Labour and Employment, Government of India.
5	The Facility Manager's Guide to Environmental Health and Safety by Brian Gallant, Government Inst Publ., 2007.
Reference Books:	
1	Fundamentals of Industrial Safety and Health by Dr.K.U.Mistry, Siddharth Prakashan, 2012.
2	Effective Environmental, Health, and Safety Management Using the Team Approach by Bill Taylor, Culinary and Hospitality Industry Publications Services, 2005

SUBJECT CODE		Program Elective -III						CREDITS
25UD1191PE604A		Highway & Railway Engineering						3
Teaching Work Load/week(Hrs.)				Examination Scheme(Marks)				
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total	
3	0	0	03	20	20	60	100	

Course Objectives	
COBJ1	To understand the classification of highways and the institutional frameworks.
COBJ2	To impart knowledge on the design principles of various highway geometric elements.
COBJ3	To introduce students to the selection and testing of highway construction materials.
COBJ4	To provide an overview of railway infrastructure components.
COBJ5	To educate students on the design, construction, and maintenance of railway track systems.

Course Outcomes: On completion of course, students will be able to	
CO1	Classify different types of highways and explain their functions, identify the institutions involved in highway development.
CO2	Describe the various cross-sectional and geometric elements of highways.
CO3	Suitable materials for highway construction and evaluate their properties.
CO4	Identify and explain the components of railway.
CO5	Explain the layout and working principles of railway operations.

Course Contents

Module 1	Highway Engineering	Hrs. 08
Classification of highways – Institutions for Highway planning, design and construction at different levels – factors influencing highway alignment -Typical cross sections of Urban and Rural roads – Engineering surveys for alignment- Conventional and Modern method.		
Module 2	Design of Highway Elements	Hrs. 08
Cross sectional elements – Horizontal curves, super elevation, transition curves, widening of curves – Sight distances – Vertical curves, gradients- pavement components and their role – Design practice for flexible and rigid pavements (IRC methods only).		
Module 3	Highway Construction & Maintenance	Hrs. 08
Highway construction materials, properties, testing methods – Construction practice of flexible and concrete pavement- Highway drainage – Evaluation and Maintenance of pavements.		
Module 4	Railway Planning & Construction	Hrs. 08
Elements of permanent way – Rails, Sleepers, Ballast, rail fixtures and fastenings, Selection of gauges – Track Stress, coning of wheels, creep in rails, defects in rails – Route alignment surveys, conventional and modern methods-Geometric design of railway, gradient, super elevation, widening of gauge on curves (Problems)-Railway drainage- Level Crossings-Signalling.		

Module 5	Railway Track Construction Maintenance & Operation	Hrs. 08
Railway Track Construction Maintenance and Operation Points and Crossings – Design of Turnouts, Working Principle-Track Circuiting – Construction & Maintenance – Conventional, Modern methods and Materials, Layouts of Railway Stations and Yards, Rolling Stock, Tractive Power, Track Resistance – Role of Indian Railways in National Development – Railways for Urban Transportation – LRT & MRTS Feasibility study, Planning and construction		

Text Books:	
1	Khanna.S. K., Justo. C.E.G and Veeraragavan A. “Highway Engineering”, Nemchand Publishers.
2	Subramanian K.P., “Highways, Railways, Airport and Harbour Engineering”, Scitech Publications (India.
3	Kadiyali.L.R. “Principles and Practice of Highway Engineering”, Khanna Technical Publications.
4	C. Venkatramaiah., Transportation Engineering-Vol. 2 Railways, Airports, Docks and Harbours, Bridges and Tunnels., Universities Press (India) Private Limited, Hyderabad, 2015.
5	Indian Road Congress (IRC), Guidelines for the Design of Flexible Pavements, (Third Revision), IRC:37-2012.
Reference Books:	
1	Indian Road Congress (IRC), Guidelines for the Design of Plain Jointed Rigid Pavements for Highways, (Third Revision), IRC:58-2012
2	Yang H. Huang, “Pavement Analysis and Design”, Pearson Education Inc, Nineth Impression, South Asia, 2012.

SUBJECT CODE		Program Elective -III						CREDITS
25UD1191PE604B		Intelligent Transportation Systems						3
Teaching Work Load/week (Hrs.)				Examination Scheme (Marks)				
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total	
3	0	0	3	20	20	60	100	

Course Objectives	
COBJ1	To introduce the concept and scope of Intelligent Transportation Systems (ITS).
COBJ2	To provide knowledge of various ITS data collection and communication technologies.
COBJ3	To explore the functional areas of ITS.
COBJ4	To analyze user needs and service requirements.
COBJ5	To understand the role of information management in ITS.

Course Outcomes: Students will be able to	
CO1	Explain ITS & ATIS.
CO2	Explain about Advanced Transportation Management System.
CO3	Explain about APTS, CVO, new technology and ETC.
CO4	Discuss about regional architecture, integration of infrastructure and operational planning.
CO5	Summarizes about ITS issues in terms of various factors and emerging issues.

Course Contents

Module 1	Introduction to Intelligent Transportation Systems (ITS)	Hrs. 8
<p>Definition of ITS and Identification of ITS Objectives, Historical Background, Benefits of ITS- safety, mobility, environmental sustainability, efficiency, Overview of ITS components and architecture, ITS stakeholders: Government, public, private sector, enforcement authorities</p> <p>ITS Data collection techniques –Roadside sensors and detectors (loop, video, infrared, microwave), Automatic Vehicle Location (AVL) systems, Automatic Vehicle Identification (AVI) systems, Role of Geographic Information Systems (GIS) and Remote Sensing, Data quality, integrity, and fusion techniques, vehicle Positioning System.</p>		
Module 2	Telecommunications in ITS	Hrs. 6
<p>Types of communications: wired vs wireless, analog vs digital, vehicle-to-Infrastructure (V2I), vehicle-to-Vehicle (V2V), and vehicle to everything (V2X) communications, role of highspeed internet, DSRC (Dedicated Short-Range Communications), and satellite-based communications, video-based data collection and analytics, role and architecture of Traffic Management Centres (TMCs), Information dissemination technologies: Variable Message Signs (VMS), web-based and mobile systems, Data storage and retrieval systems for ITS, road side communication.</p>		

Module 3	ITS functional areas	Hrs. 8
<p>Advanced Traffic Management Systems (ATMS)-Real-time traffic monitoring and control, Adaptive signal control and ramp metering, Advanced Traveler Information Systems (ATIS)-Route guidance and navigation systems, Real-time traffic and transit information for users, Advanced Vehicle Control Systems (AVCS):Collision avoidance, adaptive cruise control, lane keeping systems, Advanced Public Transportation Systems (APTS):Smart fare collection, passenger information systems, real-time fleet management, Commercial Vehicle Operations (CVO):Electronic clearance, weigh-in-motion systems, freight tracking, Advanced Rural Transportation Systems (ARTS):ITS solutions in low-density, remote areas.</p>		
Module 4	ITS User Needs and Services	Hrs. 6
<p>Framework of user needs: safety, efficiency, equity, convenience, Incident detection, congestion management, dynamic rerouting, Transit Signal Priority (TSP), scheduling, predictive arrival systems, Electronic Payment Systems: Toll collection (ETC), smart card systems, digital wallets for transit, Commercial Vehicle Operations (CVO):Fleet monitoring, route optimization, driver behaviour analysis, Emergency Management Systems: Dispatch optimization, crash notification systems (eCall), emergency vehicle signal pre-emption, Advanced Vehicle Safety Systems, Blind spot detection, driver alertness monitoring, autonomous braking, Accessibility and equity in ITS design</p>		
Module 5	Information Management	Hrs. 8
<p>Automated Highway Systems - Vehicles in Platoons, autonomous vehicle convoys – Integration of Automated Highway Systems, ITS in developing countries, institutional and organizational issues in ITS deployment, ITS architecture and standards (e.g., ISO, IEEE, NTCIP), evaluation and performance measurement of ITS, ITS in Developed Countries: ITS Programs in the World – Overview of ITS implementations in developed countries-Case studies from USA (ITS America), Japan (VICS), Europe (ERTICO), South Korea ITS in Developing Countries: Challenges and opportunities, Indian ITS policies and initiatives (e.g., MoRTH, NHAI projects, Smart Cities, Delhi Integrated Multi-Modal Transit System (DIMTS), FASTag, BRTS systems)</p>		

Text Books:	
1	Ghosh, S., Lee, T.S.,“Intelligent Transportation Systems: New Principles and Architectures”, CRC Press, 2000.
2	Mashrur A. Chowdhury, and Adel Sadek, “Fundamentals of Intelligent Transportation Systems Planning”, Artech
3	Urban Transportation: Planning, Operation and Management" – G.R. Rajasekhar
4	"Intelligent Transport Systems" – M.G. Lay & Indian adaptations
Reference Books:	
1	Sussman, J.M.,“Perspectives on Intelligent Transportation Systems”, Springer, Berlin, 2010.
2	R.P Roess, E.S. Prassas, W.R. McShane.,“Traffic Engineering”, Pearson Educational International, 3rdEdition, 2004.

SUBJECT CODE	Program Elective -III						CREDITS
25UD1191PE604C	Traffic Engineering & Management						3
Teaching Work Load/week (Hrs.)				Examination Scheme (Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
3	0	0	3	20	20	60	100

Course Objectives	
COBJ1	To learn the fundamentals of traffic engineering.
COBJ2	To learn the methods of intersection design.
COBJ3	To learn the skills of traffic control.
COBJ4	To be introduced to the different theories of traffic flow.
COBJ5	To be aware of the importance of traffic safety.

Course Outcomes: Students will be able to	
CO1	Carry out traffic studies.
CO2	Design intersections.
CO3	Implement traffic system management.
CO4	Aware of traffic flow theory.
CO5	Enhance safety in all design aspects.

Course Contents

Module 1	Introduction	Hrs. 6
Significance and scope, Characteristics of Vehicles and Road Users, Skid Resistance and Braking Efficiency (Problems), Components of Traffic Engineering- Road, Traffic and Land Use Characteristics		
Module 2	Traffic Surveys & Analysis	Hrs. 6
Surveys and Analysis - Volume, Journey time, Capacity, Speed and Delays, Origin and Destination, Parking Survey, Pedestrian Studies, Accident analysis and Safety Level of Services applications and significance.		
Module 3	Traffic Control	Hrs. 6
Traffic signs, Road markings, Design of Traffic signals and Signal co-ordination (Problems), Traffic control aids and Street furniture, Street Lighting, Computer applications in Signal design		
Module 4	Geometric Design of Intersections	Hrs. 8
Conflicts at Intersections, Classification of Intersections at Grade, - Chanallised and Unchanallised Intersection - Grade Separators (Concepts only), Principles of Intersection Design, Elements of Intersection Design, Chanallisation and Rotary design (Problems), Grade Separators		
Module 5	Traffic Management	Hrs. 8
Area traffic Management system- Traffic System Management (TSM) and Travel Demand, Management (TDM), Traffic Forecasting techniques, Restrictions on turning movements, One-way Streets, Traffic Segregation, Traffic		

Calming, Tidal flow operations, Exclusive Bus Lanes - Introduction to Intelligence, Transport System (ITS)-enforcement and education

Text Books:

- | | |
|---|--|
| 1 | Highway Engineering, Khanna K and Justo C E G, Khanna Publishers, Roorkee, 2001 |
| 2 | Traffic Engineering and Transport Planning Kadiyali L, Khanna Technical Publications, Delhi 2000 |
| 3 | Principles of Transportation Engineering" – Partha Chakroborty & Animesh Das |
| 4 | Urban Transportation: Planning, Operation and Management" – G.R. Rajasekhar |

Reference Books:

- | | |
|---|--|
| 1 | IRC Codes from Indian Roads Congress (essential for design references): IRC: 93 – Design of Traffic Signals, IRC: 106 – Guidelines for Capacity of Urban Roads, IRC: 65 – Traffic Signs, IRC: SP:90 – Manual for Road Safety Audit, IRC: SP:99- – Guidelines for Traffic Management in Work Zones |
| 2 | "Highway Traffic Analysis and Design" – R.J. Salter and N.B. Hounsell. |
| 3 | "Traffic and Highway Engineering" – Nicholas J. Garber & Lester A. Hoel |

SUBJECT CODE		<h1>Foundation Engineering</h1>						CREDITS	
25UD1191PC605								3	
3 Lectures hours/week				Examination Scheme(Marks)					
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total		
3	0	0	03	20	20	60	100		

Course Objectives	
COBJ1	To introduce soil exploration techniques and their importance in foundation engineering.
COBJ2	To understand and apply bearing capacity and settlement analysis theories.
COBJ3	To address challenges in designing foundations for problematic soils.
COBJ4	To study the design and analysis of shallow and deep foundations.
COBJ5	To examine slope stability and methods for its analysis and improvement.

Course Outcomes: On completion of course, students will be able to	
CO1	To identify and apply appropriate soil exploration and sampling methods.
CO2	Analyze the stability of slope by theoretical and graphical methods.
CO3	To compute bearing capacity and settlements using standard methods.
CO4	To design foundations for expansive, collapsible, and compressible soils.
CO5	To evaluate and design various foundation systems per IS codes.

Course Contents

Module 1	Introduction	Hrs. 08
General requirements to be satisfied for satisfactory performance of foundations, Soil exploration: Necessity, Planning, Exploration Methods, Soil Sampling Disturbed and undisturbed, Rock Drilling and Sampling, Core Barrels, Core Boxes, Core Recovery, Field Tests for Bearing Capacity evaluation, Test Procedure & Limitations		
Module 2	Bearing Capacity Analysis	Hrs. 10
Failure Modes, Terzaghi's Analysis, Specialization of Terzaghi's Equations, Skempton Values for N_c , Meyerhof's Analysis, I.S. Code Method of Bearing Capacity Evaluation, Effect of Water Table, Eccentricity of load, Safe Bearing Capacity and Allowable Bearing Pressure, Settlement Analysis: Immediate Settlement - Consolidation Settlement, Differential Settlement, Tolerable Settlement, Angular distortion		
Module 3	Foundations for Difficult Soils	Hrs. 10
Guidelines for Weak and Compressible Soils, Expansive soil, Parameters of Expansive Soils, Collapsible Soils and Corrosive Soils, Causes of Moisture changes in Soils, Effects of Swelling on Buildings, Preventative measures for Expansive Soils, Design of Foundation on Swelling Soils, Ground Improvement Methods: for general considerations, for Cohesive Soils, for Cohesionless Soils, Shallow Foundations: Assumptions & Limitations of Rigid Design Analysis, Safe Bearing Pressure, Settlement of Footings, Design of isolated, Combined, Strap Footing (Rigid analysis), Raft Foundation (Elastic Analysis), I. S. Code of Practice for Design of Raft Foundation		

Module 4	Deep foundations	Hrs. 8
Pile Foundation: Classification, Pile Driving, Load Carrying Capacity of Piles, Single Pile Capacity, Dynamic Formulae, Static Formulae, Pile Load Tests, Penetration Tests, Negative skin Friction, Under Reamed Piles, Group Action of Piles, Caissons Foundations: Box, Pneumatic, Open Caissons, Forces, Grip Length, Well Sinking, Practical Difficulties and Remedial Measures Sheet Piles: Classification, Design of Cantilever Sheet Pile in Cohesionless and Cohesive soils. Design of Anchored Sheet Pile by Free Earth Support Method, Cellular Cofferdams: Types, Cell Fill Stability Considerations		
Module 5	Slope Stability	Hrs. 8
Different Definitions of Factors of Safety, Types of Slope Failures, Stability of an Infinite Slope of Cohesionless Soils, Stability Analysis of an Infinite Slope of Cohesive Soils, Stability of Finite Slopes- Slip Circle Method, Semi Graphical and Graphical Methods, Friction Circle Method, Stability Number: Concept and its use		

Text Books:	
1	Kasamalkar, B.J., “Foundation Engineering”, Pittsburgh vintage Grand Prix
2	Murthy V.N.S., “Soil Mechanics and Foundation Engineering”, CRC Press 2002
3	Arora K.R., “Soil Mechanics and Foundation Engineering”, Standard publication 2009
4	Punmia B. C., “Soil Mechanics and Foundation Engineering”, Laxmi publication 16th 2017
5	Nayak N.V., “Foundation Design Manual”, Dhanpat Rai and Son
6	Brahma S.P., “Foundation Engineering”, Tata McGraw-Hill 5th Edition
7	Bowles J.E., “Foundation analysis & Design”, McGraw-Hill Higher Education 5th edition
Reference Books:	
1	Teng W.C., “Foundation Design”, Prentice-Hall Inc
2	Tomlinson M.J., “Foundation Design & Construction”, Prentice-Hall; 7th edition
3	Lee, “Sheet Piles” Concrete Publication, 1961
4	Relevant Publications by Bureau of Indian Standards, New Delhi
5	IS 6403:1981, IS 1904:1986, IS 4091:1979

SUBJECT CODE		Multi-Disciplinary Minor-III Town and Urban Planning						CREDITS
25UD1191MD606								3
3 Lectures hours/week				Examination Scheme (Marks)				
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total	
3	0	0	03	20	20	60	100	

Course Objectives	
COBJ1	Understand the fundamentals of town and urban planning.
COBJ2	Learn about land use planning, zoning regulations, and development control rules.
COBJ3	Familiarize with the legal, institutional, and administrative framework.
COBJ4	Understand the planning and design of urban infrastructure systems.
COBJ5	Explore the principles of sustainable and smart urban development.

Course Outcomes: On completion of course, students will be able to	
CO1	Describe the basic concepts, historical background, and objectives of town and urban planning.
CO2	Interpret land use classifications, zoning regulations, and apply development control norms.
CO3	Analyze and evaluate components of master plans and understand the process of urban plan formulation.
CO4	Apply basic planning concepts to urban transport and infrastructure systems using standard guidelines.
CO5	Assess urban planning solutions from sustainability, environmental, and smart city perspectives.

Course Contents

Module 1	Introduction to Urban Planning	Hrs. 08
Definition and scope of town and urban planning, History and evolution of cities (Indus Valley to modern India), Urbanization trends in India, Basic city structure models: Concentric Zone, Sector, Multiple Nuclei, Importance of planning in infrastructure, environment, and mobility.		
Module 2	Land Use Planning and Zoning	Hrs. 08
Types of land use: residential, commercial, industrial, institutional, green zones, Zoning and its importance in planning, Master Plans and Development Plans, Floor Area Ratio (FAR), density, building height, setbacks, Building bye-laws, Development Control Rules (DCR), Use of GIS in urban planning.		
Module 3	Master Planning and Legal Framework	Hrs. 10
Layout of Residential Units, Neighborhood Unit Planning, Radburn Plan, Grid Iron Pattern, Shoe String Development, Growth Pattern of Towns, Concentric Satellite, Ribbon Development, Scattered growth, Hierarchy of plans: Regional Plan, Master Plan, Local Area Plan, Process of Master Plan preparation, Planning authorities: municipal bodies, development authorities, Relevant Acts: Town & Country Planning Act, MRTTP Act, 74th Amendment, Land acquisition basics and regulatory tools.		
Module 4	Urban Infrastructure and Transport Planning	Hrs. 10

Elements of Town, Various Zones, Development Control Rules and Building Bye Laws, Urban Roads: Objective, Classification, Road Networks, Data Collection Surveys, Analysis of data, Town aesthetics, Landscape Architecture, Suitability of Trees, Treatment of Traffic Islands, Open Spaces Walkways Public Sit-outs, Continuous Park System, Green ways, Town Planning works with reference to M.R.T.P. Act, Land Acquisition Act, Necessity and procedure of acquisition		
Module 5	Environment, Sustainability and Smart Cities	Hrs. 10
Role of green spaces, pollution control, climate resilience, Principles of sustainable and inclusive urban planning, Slum rehabilitation and affordable housing, Smart Cities Mission: ICT-based solutions, smart governance, Case studies of Smart Cities in India.		
Village Planning, Multilevel Planning, Decentralization Concepts, Rural Developments, Planning Methodology, Growth Centre Approach, Area Development Approach, Integrated Rural Development Approach		

Text Books:	
1	S.C. Rangwala – Town Planning
2	Hiraskar G.K. (2018) “Town and country Planning” Dhanpat Rai Publication, N. Delhi
3	Sundaram K.V. (1978) “Urban and Regional Planning in India”, Vikash Publishing House P.L
4	Misra S. N. (1984) “Rural Development Planning-Design and Method”, Satvahan Publications.
5	Eisner S. and Gallion A. (1993) “The Urban Pattern”, John Wiley & Sons, N. Delhi
Reference Books:	
1	URDPFI Guidelines (MoHUA, 2014)
2	Smart Cities Mission Guidelines (2015)
3	CPHEEO Manuals, NBC 2016, IRC Codes
4	MRTP Act 1966 & 2002
5	Land Acquisition Act - 1894

SUBJECT CODE		Multi-Disciplinary Minor-III Planning for Sustainable Development						CREDITS
25UD1191MD606								3
3 Lectures hours/week				Examination Scheme (Marks)				
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total	
3	0	0	03	20	20	60	100	

Course Objectives:	
COBJ1	To familiarize the concept of sustainable development
COBJ2	To introduce various components of sustainable development
COBJ3	Analyze global and local attempts to achieve sustainable development, with a focus on planning strategies that address the SDGs
COBJ4	Understand the fundamentals of sustainable development and planning, particularly in the context of the SDGs.
COBJ5	Integrate sustainable development principles into national and regional development planning, emphasizing the challenges faced in implementing such policies

Course Outcomes: On completion of course, students will be able to	
CO1	Explain the importance of sustainable development.
CO2	Use various strategies for promoting sustainable development.
CO3	Analyze important current issues and areas of debate in relation to sustainable development.
CO4	Understand theories of sustainable development.
CO5	Implement policy responses in environmental degradation.

Course Contents

Module 1	Introduction	Hrs. 08
Sustainable Development-explains and critically evaluates the concept of sustainable development, Environmental degradation and poverty Sustainable development: its main principles, the evolution of ideas about sustainability.		
Module 2	Key Components in Sustainable Development	Hrs. 08
Strategies for promoting sustainable development, resistances to the concept, and some alternative approaches. Examine some important current issues and areas of debate in relation to sustainable development.		
Module 3	Innovation for Sustainable Development	Hrs. 06
Innovation for sustainable development- Environmental management and innovation strategies. Capacity development for innovation. Research methods.		
Module 4	Theories of Sustainable Development	Hrs. 06
Societal transformations. Institutional theory		
Module 5	Governance and Policy Response	Hrs. 06
Governance for sustainable development. Policy responses to environmental degradation. Capacity development for innovation. Research methods		

Text Books:	
1	Basic Principles for Sustainable Development, Harris, J.M, 2004.
2	Some thoughts on the idea of sustainable development Ecological Economics, Robinson, J. (2004).
3	Navigating towards Sustainable Development: A System Dynamics Approach, Hjorth, P. and A. Bagheri (2006), Futures 38: 74-92
4	Struggling with Sustainability – A Comparative Framework for Evaluating Sustainable Development Programs, Mog, J.M. (2004), World Development 32(12): 2139–2160. IISD Commentary on the OECD’s Draft Principles for International Investor Participation in Infrastructure
5	Global Development and Environment Institute, working paper 00-04. Available at: http://ase.tufts.edu/gdae/publications/Working_Papers/Sustainable%20Development.PDF
Reference Books:	
1	Engineering Applications in Sustainable Design & Development – Bradley A. Striebig, 2015.
2	Principles of Sustainable Aquaculture – S. W. Bunting, 2013.
3	The Future of Sustainable Cities: Critical Reflections – John Flint (Ed.),2012

SUBJECT CODE		<h1>Design of Concrete Structures Lab</h1>				CREDITS	
25UD1191PCL607						1	
Teaching Work Load/week (Hrs.)				Examination Scheme (Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
0	0	2	2	25	-	25	50

Course Outcomes: On completion of course, students will be able to	
CO1	Identify and interpret design requirements of RCC structural elements. (Remembering/Understanding)
CO2	Analyze structural behavior under various loading conditions. (Analyzing)
CO3	Design RCC components as per IS 456 provisions. (Applying/Creating)
CO4	Create detailed structural drawings using manual and CAD tools. (Creating)
CO5	Justify design choices and evaluate structural safety and serviceability. (Evaluating)

Course Contents

Practical Work consists of at least eight performances from list below and detailed reporting in form of journal.

Experiment No 1	Design and detailing of G+2 RCC framed structure (Compulsory).
Experiment No 2	Design and detailing of a cantilever or counterfort retaining wall.
Experiment No 3	Analysis and design of elevated water tank with staging (circular/intze).
Experiment No 4	Design of a helicoidal or bifurcated staircase.
Experiment No 5	Design of a cylindrical or conical shell roof (conceptual).
Experiment No 6	Design of combined footing for two columns.
Experiment No 7	Design of rectangular raft foundation.
Experiment No 8	Design layout and analysis of pile foundation group (basic introduction and detailing).
Experiment No 9	Preparation of reinforcement detailing drawings for beam, slab, and column (manual/CAD).
Use of computer programs such as MS Excel is desirable for post-processing of results.	

SUBJECT CODE		Program Elective -II						CREDITS
25UD1191PEL608A		Water Quality Engineering Lab						1
Teaching Work Load/week(Hrs.)				Examination Scheme(Marks)				
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total	
0	0	2	2	25	-	25	50	

Course Outcomes: On completion of course, students will be able to	
CO1	Determine key physical and chemical water quality parameters such as pH, turbidity, and TDS using standard instruments.
CO2	Analyze alkalinity and hardness of water samples to evaluate buffering capacity and scaling potential.
CO3	Perform BOD and COD tests to assess organic pollution levels in water and wastewater.
CO4	Interpret the working of a reverse osmosis (RO) unit.

Course Contents

Practical Work consists of at least eight performances from list below and detailed reporting in form of journal.

Experiment No 1	Determination of pH of Water Sample
Experiment No 2	Determination of Turbidity
Experiment No 3	Estimation of Total Dissolved Solids (TDS)
Experiment No 4	Determination of Alkalinity of Water.
Experiment No 5	Determination of Total Hardness and Calcium Hardness.
Experiment No 6	Estimation of Chlorides.
Experiment No 7	Estimation of Dissolved Oxygen (DO)
Experiment No 8	Determination of Biochemical Oxygen Demand (BOD)
Experiment No 9	Determination of Chemical Oxygen Demand (COD)
Experiment No 10	Demonstration of Reverse Osmosis (RO) Unit
Experiment No 11	Visit to a Water or Wastewater Treatment Plant.
Use of computer programs such as MS Excel is desirable for post-processing of results.	

SUBJECT CODE		Program Elective-III Highway & Railway Engineering Lab						CREDITS
25UD1191PEL609A								1
Teaching Work Load/week(Hrs.)				Examination Scheme(Marks)				
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total	
0	0	2	2	25	-	25	50	

Course Outcomes: On completion of course, students will be able to	
CO1	Conduct and interpret results from aggregate crushing, impact, abrasion, and shape tests to assess their suitability for use in road construction.
CO2	Perform penetration, softening point, ductility, flash & fire point, and viscosity tests to determine the performance characteristics of bituminous materials.
CO3	Assess binder content and stripping value to evaluate mix stability and moisture susceptibility in bituminous mixtures.
CO4	Conduct and analyze Marshall stability tests to evaluate the strength and deformation characteristics of bituminous mixes.
CO5	Gain hands-on experience in executing laboratory tests on aggregates and bitumen, and interpreting results as per relevant IS/ASTM standards.

Course Contents

Practical Work consists of at least eight performances from list below and detailed reporting in form of journal.

Experiment No 1	Aggregate crushing value test
Experiment No 2	Aggregate impact value test
Experiment No 3	Los Angeles abrasion test
Experiment No 4	Aggregate shape test
Experiment No 5	Penetration test of bitumen
Experiment No 6	Softening point test of bituminous material
Experiment No 7	(a) Flash and fire point test of bituminous material (b) Viscosity test of bituminous material
Experiment No 8	Ductility test of bitumen
Experiment No 9	(a) Determination of binder content of asphalt mix (b) Determination of stripping value of aggregate
Experiment No 10	Marshall stability test of bituminous mix
Use of computer programs such as MS Excel is desirable for post-processing of results.	

SUBJECT CODE		Program Elective-III						CREDITS
25UD1191PEL609B		Intelligent Transportation Systems Lab						1
Teaching Work Load/week(Hrs.)				Examination Scheme(Marks)				
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total	
0	0	2	2	25	-	25	50	

Course Outcomes: On completion of course, students will be able to	
CO1	Explain the principles, objectives, and historical development of urban and town planning.
CO2	Interpret land use classifications, zoning regulations, and apply development control rules in planning exercises.
CO3	Analyze the components of Master Plans and evaluate the legal and institutional framework of planning in India
CO4	Apply basic concepts to plan urban infrastructure such as roads, water supply, sewerage, and drainage.
CO5	Assess planning strategies for sustainable development and smart cities with a focus on environmental considerations.

Course Contents

Practical Work consists of at least eight performances from list below and detailed reporting in form of journal.

Experiment No 1	Introduction to Urban Base Maps & Survey Tools- a) Understanding toposheets, satellite imagery, and municipal base maps b) Introduction to GIS/AutoCAD/Google Earth for basic mapping
Experiment No 2	Land Use Mapping of a Locality- a) Field visit or remote mapping of a ward or neighborhood b) Categorize plots into residential, commercial, public/semi-public, green, etc. c) Prepare a land use map (manual or using GIS)
Experiment No 3	Plot Layout and Subdivision Planning- a) Design a residential layout with proper plot sizes, roads, and amenities b) Apply development control norms: FAR, setbacks, open space, etc.
Experiment No 4	Zoning Map Preparation- a) Create a basic zoning plan for a small urban area based on surveyed data b) Apply compatible zoning: residential, commercial, institutional, recreational
Experiment No 5	Master Plan Case Study- a) Review an existing Master Plan of a city (e.g., Delhi, Pune, Indore, etc.) b) Identify key land use proposals, transport networks, and growth areas c) Submit a summary report with maps and observations
Experiment No 6	Development Control Rules (DCR) Exercise- a) Analyze local building bye-laws and DCR (e.g., height limits, plot coverage) b) Prepare a report on compliance of a building with DCR norms
Experiment No 7	Urban Transportation Planning Exercise- a) Map a road network hierarchy (arterial, collector, local roads) b) Suggest basic traffic control measures, intersection design or BRT corridor.
Experiment No 8	Infrastructure Planning Mini-Project- a) Plan water supply/sewerage for a residential block (20–30 plots). b) Basic pipe sizing, layout sketching as per CPHEEO guidelines.
Experiment No 9	Smart City Component Mapping- a) Identify and mark ICT-based services (e-governance, smart lighting, surveillance) b) Case study of a smart city implementation in India.

Experiment No 10	Slum Redevelopment Plan a) Create a simple layout showing redevelopment of a slum area b) Include resettlement housing, basic amenities, and green space
Project Title: Preparation of a Land Use Plan for a Small Urban Area / Neighborhood (2–5 sq.km) Components: Site analysis and land use survey, Base map preparation, Proposed zoning plan, Infrastructure layout (roads, water, sewage), Development control norms, Sustainability or smart city elements, Presentation and Report	

SUBJECT CODE		Program Elective-III				CREDITS	
25UD1191PEL609C		Traffic Engineering & Management Lab				1	
Teaching Work Load/week(Hrs.)				Examination Scheme(Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
0	0	2	2	25	-	25	50

Course Outcomes: On completion of course, students will be able to	
CO1	Collect and analyze real-world traffic data (speed, volume, O–D, parking).
CO2	Design traffic signals and interpret LOS of urban roads.
CO3	Apply IRC guidelines in traffic management decisions.
CO4	Suggest basic improvements for safety and traffic efficiency.
CO5	Prepare technical reports and graphical presentations of traffic studies.

Course Contents

Practical Work consists of at least eight performances from list below and detailed reporting in form of journal.

Exp.No.1	Spot Speed Study – Measurement of vehicle speed using stopwatch or radar gun.
Exp.No.2	Volume Count Study – Classified traffic volume count using manual or video method.
Exp.No.3	Traffic Density and Flow Analysis – Compute traffic flow parameters (q, k, v).
Exp.No.4	Origin–Destination (O–D) Survey – Using license plate matching / roadside interviews.
Exp.No.5	Parking Study – Parking accumulation and turnover study for on-street/off-street areas.
Exp.No.6	Delay and Queue Length Study – At uncontrolled or signalized intersections.
Exp.No.7	Traffic Signal Design – Design a fixed-time signal using Webster’s method.
Exp.No.8	Saturation Flow and Level of Service (LOS) estimation based on IRC:106 guidelines.
Exp.No.9	Intersection Capacity Analysis – Determine capacity of a four-arm intersection.
Exp.No.10	Road Accident Data Analysis – Using sample police reports or traffic survey data.
Exp.No.11	Installation & Study of Traffic Signs/Markings – Interpretation using IRC:67 & IRC:35.
Project – Propose traffic improvement measures for a selected junction/area.	

SUBJECT CODE		<h1>Seminar</h1>				CREDITS	
25UD1191EL610						1	
Teaching Work Load/week(Hrs.)				Examination Scheme(Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
0	0	2	2	25	-	25	50

Course Objectives	
COBJ1	Identify technical and practical challenges within the field of civil engineering.
COBJ2	Develop the ability to interpret, analyze, and communicate technical information effectively.
COBJ3	Strengthen skills in technical report writing and presentation through critical thinking and structured documentation
COBJ4	Learn referencing and plagiarism avoidance techniques.

Course Outcomes: On completion of course, students will be able to	
CO1	Understand and evaluate ongoing research, advancements, and interdisciplinary applications in civil engineering.
CO2	Conduct and organize a comprehensive literature survey using scholarly resources such as journals, books, and technical documents.
CO3	Analyze and derive conclusions from the selected technical topic.
CO4	Prepare and present a structured technical report demonstrating critical analysis.
CO5	Enhance their technical writing and oral communication skills

<h2>Guidelines for seminar work</h2>	
1	The seminar report should include the following elements. Internal guides may use a continuous evaluation sheet for each student, which will contribute to the term work assessment.
2	Introduction: Background of the selected topic, its relevance to civil engineering, the need for the study, objectives, and scope along with any limitations.
3	Literature Review: Summary and analysis of literature from books, journals, conference papers, technical reports, and other scholarly documents—preferably from the last five years.
4	Theoretical Content: Core subject matter related to the topic, including models, equations, methods, or relevant case studies.
5	Conclusion: Final observations, outcomes of the study, and potential future scope.
6	References: Properly cited sources used throughout the seminar report.
<h2>Guidelines for Assessment</h2>	
Panel of staff members along with a guide will assess the seminar work based on these parameters- Topic, Contents and Presentation, regularity, Punctuality and Timely Completion, Question and Answers, Report, Paper presentation/Publication, Attendance and Active Participation.	

SUBJECT CODE		<h1>Academic Research Writing</h1>				CREDITS	
25UD1191VS611						3	
Teaching Work Load/week (Hrs.)				Examination Scheme (Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
0	0	2	2	25	-	25	50

Course Objectives	
COBJ1	To introduce students to the fundamentals of academic writing
COBJ2	To develop critical reading and literature review skills.
COBJ3	To strengthen students' ability to plan, draft, and revise structured academic content.
COBJ4	To enhance students' command of academic style, language, and referencing.
COBJ5	To prepare students for academic publishing and professional communication.

Course Outcomes: On completion of course, students will be able to	
CO1	Identify (Remember) types and characteristics of academic writing.
CO2	Analyze (Analyze) and synthesize scholarly literature for review.
CO3	Construct (Create) well-structured academic and technical documents.
CO4	Apply (Apply) appropriate citation styles and referencing techniques.
CO5	Evaluate (Evaluate) content for plagiarism and ethical compliance.

Course Contents

Module 1	Introduction to Academic Research	Hrs. 08
Definition, purpose, and types of academic writing, Differences between academic and non-academic writing, Research ethics and integrity in writing, Structure of a research paper, report, and thesis, Common errors in academic writing		
Module 2	Literature Review and Critical Reading	Hrs. 08
Importance and purpose of literature review, Finding and selecting credible sources, Techniques for reading and analyzing research papers, Synthesizing literature: thematic and chronological review, Tools for managing references (Zotero/ Mendeley/EndNote)		
Module 3	Writing Process and Structure	Hrs. 08
Drafting abstracts, introductions, and conclusions, Writing coherent body paragraphs and sections, Data presentation: Tables, figures, and charts, Argumentation and logical flow in writing, Writing summaries, paraphrasing, and quoting		
Module 4	Style, Language, and Referencing Techniques	Hrs. 08
Formal tone, academic vocabulary, and sentence structure, Common language issues: passive vs. active voice, conciseness, Citation styles: APA, IEEE, MLA – rules and examples, In-text citations and bibliography		

preparation, Avoiding plagiarism: definition, consequences, and tools (Turnitin)		
Module 5	Writing for Publication and Technical Communication	Hrs. 08
Selecting journals and understanding author guidelines, Writing research proposals and conference abstracts, Peer review process and publication ethics, Technical reports, project documentation, and grant writing, Presenting research findings: posters and oral presentations		

Text Books:	
1	Day, R. A., & Gastel, B. <i>How to Write and Publish a Scientific Paper</i> , Cambridge University Press.
2	Greetham, B. <i>How to Write Better Essays</i> , Palgrave Macmillan.
3	Bailey, S. <i>Academic Writing: A Handbook for International Students</i> , Routledge.
4	Booth, W. C., Colomb, G. G., & Williams, J. M. <i>The Craft of Research</i> , University of Chicago Press.
5	Glasman-Deal, H. <i>Science Research Writing for Non-Native Speakers of English</i> , Imperial College Press.
Reference Books:	
1	Swales, J. M., & Feak, C. B. <i>Academic Writing for Graduate Students</i> , University of Michigan Press.
2	Murray, R. <i>How to Write a Thesis</i> , Open University Press.

SUBJECT CODE		<h1>Project Phase-I</h1>				CREDITS	
25UD1191EL612						2	
Teaching Work Load/week(Hrs.)				Examination Scheme(Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
0	0	4	4	50	-	50	100

Course Objectives	
COBJ1	To identify a real-world civil engineering problem.
COBJ2	To conduct detailed literature review and problem formulation.
COBJ3	To define project objectives, methodology, and expected outcomes.
COBJ4	To develop preliminary design / experimental / analytical framework.
COBJ5	To prepare a comprehensive project proposal report.

Course Outcomes: On completion of course, students will be able to	
CO1	Identify and define a research/industry problem in Civil Engineering.
CO2	Conduct critical literature review using reputed journals (Scopus, SCI, etc.).
CO3	Develop methodology and work plan for the project.
CO4	Perform preliminary analysis/design/experimental planning.
CO5	Prepare and present a technical project proposal.

<h2>Guidelines for Project Phase-I</h2>	
Project work can be done in a group of students. (Min 3-Max.5.)	
1	Problem Identification: Students shall select a suitable project topic from any specialization of Civil Engineering and obtain approval of the topic and project title from the allotted guide. A clear and well-defined problem statement must be prepared.
2	Literature Review: A comprehensive review of at least 10–15 research papers from reputed journals shall be conducted. Based on the review, research gaps must be identified and a comparative analysis table should be prepared.
3	Project Planning: The objectives and scope of the project shall be finalized. An appropriate methodology (Experimental / Analytical / Numerical / Field-based) must be defined along with a detailed work schedule.
4	Preliminary Work: Preliminary activities such as pilot study, experimental setup design, software modelling framework, and material procurement planning shall be carried out as applicable.
5	Documentation and Presentation: The synopsis/report and presentation must be completed within the stipulated time.
Internal guides may use a continuous evaluation sheet for each student, which will contribute to the term work assessment. <i>Project diary must be maintained with guide to keep the records of students-guide interactions during the semester.</i>	

Guidelines for Assessment

Panel of staff members along with a guide will assess the project phase -I work based on these parameters- Topic, Contents and Presentation, regularity, Punctuality and Timely Completion, Question and Answers, Report, Paper presentation/Publication, Attendance and Active Participation.

Following evaluation criteria can be used as a guideline

Component	Marks
Literature Review	20
Problem Formulation	15
Methodology & Planning	20
Seminar Presentation	20
Report Quality	25
Total	100