SYLLABUS OF B.E. CIVIL ENGINEERING OF SEMESTER-VI TO VIII

FIRST YEAR ENGINEERING: COMMON TO ALL BRANCHES

SCHEME OF INSTRUCTION AND EXAMINATION
(RC 2016-17)

SEMESTER – I

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P#	Th Duration (Hrs)	Marks					
						Th	S	TW	P	O	Total
FE 1.1	Engineering Mathematics -I	4	--	--	3	100	25	--	--	--	**125**
FE 1.2	Applied Sciences- (Physics) / (Chemistry)	3	--	2	3	100	25	25	--	--	**150**
FE 1.3	Engineering Mechanics	3	--	2	3	100	25	25	--	--	**150**
FE 1.4	Fundamentals of Electrical Engineering	3	--	2	3	100	25	--	--	--	**125**
FE 1.5	Fundamentals of Computer Engineering	3	--	2	3	100	25	--	--	--	**125**
FE 1.6	Technical English	3	--	--	3	100	25	--	--	--	**125**
FE 1.7	Workshop Practice - I*	--	--	4	--	--	--	50	--	--	**50**
TOTAL		**19**	**--**	**12**	**--**	**600**	**150**	**100**	**--**	**--**	**850**

* **Term Work in Workshop Practice - I is a Separate Head of Passing**

A candidate is considered to have successfully fulfilled the requirement of a semester, provided he/ she submits to the department a certified journal reporting the experiments conducted during the semester.

FIRST YEAR ENGINEERING: COMMON TO ALL BRANCHES

SCHEME OF INSTRUCTION AND EXAMINATION

(RC 2016-17)

SEMESTER – II

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
					Th Duration (Hrs)	Marks					
		L	T	P#		Th	S	TW	P	O	Total
FE 2.1	Engineering Mathematics -II	4	--	--	3	100	25	--	--	--	**125**
FE 2.2	Applied Sciences- (Physics) / (Chemistry)	3	--	2	3	100	25	25	--	--	**150**
FE 2.3	Programming Languages	3	--	2	3	100	25		--	--	**125**
FE 2.4	Fundamentals of Electronics and Tele-Communication Engineering	3	--	2	3	100	25	--	--	--	**125**
FE 2.5	Environmental Sciences and Social sciences	3	--	--	3	100	25	--	--	--	**125**
FE 2.6	Engineering Graphics	2	--	4	4	100	25	25	--	--	**150**
FE 2.7	Workshop Practice - II*	--	--	4	--	--	--	50	--	--	**50**
TOTAL		**18**	**--**	**14**	**--**	**600**	**150**	**100**	**--**	**--**	**850**

* **Term Work in Workshop Practice - II is a Separate Head of Passing**

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SECOND YEAR ENGINEERING: CIVIL ENGINEERING

SCHEME OF INSTRUCTION AND EXAMINATION

(RC 2016-17)

SEMESTER – III

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P#	Th Duration (Hrs)	Marks					
						Th	S	TW	P	O	Total
CE 3.1	Concrete Technology	3	--	2	3	100	25	--	25	--	**150**
CE 3.2	Mechanics of Materials	3	1	2	3	100	25	--	25	--	**150**
CE 3.3	Fluid Mechanics-I	3	1	2	3	100	25	--	--	25	**150**
CE 3.4	Building Materials and Construction	4	--	2	3	100	25	25	--	--	**150**
CE 3.5	Engineering Mathematics -III	3	1	--	3	100	25	--	--	--	**125**
CE 3.6	Managerial Economics	3	--	--	3	100	25	--	--	--	**125**
TOTAL		**19**	**3**	**8**	**--**	**600**	**150**	**25**	**50**	**25**	**850**

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SECOND YEAR ENGINEERING: CIVIL ENGINEERING

SCHEME OF INSTRUCTION AND EXAMINATION

(RC 2016-17)

SEMESTER – IV

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P#	Th Duration (Hrs)	Marks					
						Th	S	TW	P	O	Total
CE 4.1	Surveying - I	3	--	2	3	100	25	--	25	--	**150**
CE 4.2	Fluid Mechanics-II	3	--	2	3	100	25	--	--	--	**125**
CE 4.3	Building Drawing - I	3	--	3	4	100	25	25	--	--	**150**
CE 4.4	Structural Analysis - I	4	--	--	3	100	25	--	--	25	**150**
CE 4.5	Numerical Methods and Computer Programming	3	--	2	3	100	25	--	--	--	**125**
CE 4.6	Engineering Geology	3	--	2	3	100	25	--	25	--	**150**
TOTAL		**19**	**--**	**11**	**--**	**600**	**150**	**25**	**50**	**25**	**850**

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THIRD YEAR ENGINEERING: CIVIL ENGINEERING

SCHEME OF INSTRUCTION AND EXAMINATION

(RC 2016-17)

SEMESTER V

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P#	Th Duration (Hrs)	Marks					
						Th	S	TW	P	O	Total
CE 5.1	Structural Analysis- II	4	1	--	3	100	25	--	--	25	**150**
CE 5.2	Design of Concrete Structures -I	4	1	--	3	100	25	--	--	--	**125**
CE 5.3	Design of Steel Structures- I	4	--	--	3	100	25	--	--	--	**125**
CE 5.4	Geotechnical Engineering- I	3	--	2	3	100	25	--	25	--	**150**
CE 5.5	Transportation Engineering- I	3	--	2	3	100	25	--	25	--	**150**
CE 5.6	Building Drawing- II	3	--	3	4	100	25	25	--	--	**150**
TOTAL		**21**	**2**	**7**	**--**	**600**	**150**	**25**	**50**	**25**	**850**

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THIRD YEAR ENGINEERING: CIVIL ENGINEERING

SCHEME OF INSTRUCTION AND EXAMINATION

(RC 2016-17)

SEMESTER VI

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P#	Th Duration (Hrs)	Marks					
						Th	S	TW	P	O	Total
CE 6.1	Design of Concrete Structures- II	4	1	--	3	100	25	--	--	25	**150**
CE 6.2	Design of Steel Structures- II	3	--	2	3	100	25	25	--	--	**150**
CE 6.3	Geotechnical Engineering- II	4	1	--	3	100	25	--	--	--	**125**
CE 6.4	Transportation Engineering- II	3	1	--	3	100	25	--	--	--	**125**
CE 6.5	Environmental Engineering- I	3	1	2	3	100	25	--	25	--	**150**
CE 6.6	Surveying- II	3	--	2	3	100	25	--	25	--	**150**
TOTAL		**20**	**4**	**6**	**--**	**600**	**150**	**25**	**50**	**25**	**850**

A candidate is considered to have successfully fulfilled the requirement of a semester, provided he/ she submits to the department a certified journal reporting the experiments conducted during the semester.

FINAL YEAR ENGINEERING: CIVIL ENGINEERING

SCHEME OF INSTRUCTION AND EXAMINATION

(RC 2016-17)

SEMESTER VII

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P#	Th Duration (Hrs)	Marks					
						Th	S	TW	P	O	Total
CE 7.1	Design of Concrete Structures- III	3	--	2	3	100	25	--	--	--	125
CE 7.2	Environmental Engineering- II	3	1	2	3	100	25	--	25	--	150
CE 7.3	Estimation, Costing and Valuation	3	--	2	3	100	25	--	--	--	125
CE 7.4	Elective- I	3	--	2	3	100	25	--	--	25	150
CE 7.5	Elective- II	3	--	2	3	100	25	--	--	25	150
CE 7.6	Project	--	--	4	--	--	--	--	--	25	25
TOTAL		**15**	**1**	**14**	**--**	**500**	**125**	**--**	**25**	**75**	**725**

A candidate is considered to have successfully fulfilled the requirement of a semester, provided he/ she submits to the department a certified journal reporting the experiments conducted during the semester.

List of Electives

Elective -I		Elective- II	
CE 7.4.1	Environmental Pollution and Control	CE 7.5.1	Applied Engineering Geology
CE 7.4.2	Finite Element Method	CE 7.5.2	Disaster Management
CE 7.4.3	Occupational Safety and Health Acts	CE 7.5.3	Traffic Engineering
CE 7.4.4	Advances in Concrete Technology	CE 7.5.4	Structural Dynamics
CE 7.4.5	Reinforced Earth Structures	CE 7.5.5	Structural Design of Foundations

FINAL YEAR ENGINEERING: CIVIL ENGINEERING

SCHEME OF INSTRUCTION AND EXAMINATION

(RC 2016-17)

SEMESTER VIII

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P#	Th Duration (Hrs)	Marks					
						Th	S	TW	P	O	Total
CE 8.1	Irrigation and Water Resources Engineering	4	1	--	3	100	25	--	--	--	125
CE 8.2	Construction Machinery and Project Management	4	1	2	3	100	25	--	25	--	150
CE 8.3	Elective- III	3	--	2	3	100	25	--	--	25	150
CE 8.4	Elective- IV	3	--	2	3	100	25	--	--	25	150
CE 8.5	Project*	--	--	8	--	--	--	75	--	75	150
TOTAL		**14**	**2**	**14**	**--**	**400**	**100**	**75**	**25**	**125**	**725**

* **Term Work in Project is a Separate Head of Passing**

A candidate is considered to have successfully fulfilled the requirement of a semester, provided he/ she submits to the department a certified journal reporting the experiments conducted during the semester.

List of Electives

Elective- III		Elective- IV	
CE 8.3.1	Industrial and Municipal Waste Management	CE 8.4.1	Advanced Pre-stressed Concrete
CE 8.3.2	Advanced Structural Analysis	CE 8.4.2	Green Building Design
CE 8.3.3	Ground Improvement Techniques	CE 8.4.3	Repairs and Rehabilitations of Structures
CE 8.3.4	Design of Earthquake Resistant Structures	CE 8.4.4	Pavement Design
CE 8.3.5	Advanced Materials and Construction Techniques	CE 8.4.5	Design of Reinforced Concrete Bridges

CE 5.1 STRUCTURAL ANALYSIS - II

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Instruction						
						Marks					
		L	T	P	Th. Duration (Hrs)	TH	S	TW	P	O	Total
CE 5.1	Structural Analysis - II	4	1	--	3	100	25	--	--	25	**150**

Course Objectives:

1. To impart the principles of elastic structural analysis and behaviour of indeterminate structures.
2. To impart knowledge about various methods involved in the analysis of indeterminate structures.
3. To apply these methods for analyzing the indeterminate structures to evaluate the response of structures
4. To enable the student get a feeling of how real-life structures behave
5. To make the student familiar with latest computational techniques and software used for structural analysis.

Course Outcomes:

The student after undergoing this course will be able to:

1. To understand analysis of indeterminate structures and adopt an appropriate structural analysis technique
2. Determine response of structures by classical, iterative and matrix methods

UNIT - 1 (16 Hours)

Slope-Deflection Method of Analysis: Slope-deflection equations, Equilibrium equation of slope-deflection method, Application to beams with and without joint translation and rotation, Yielding of support, Application to non-sway rigid jointed rectangular portal frames, Shear force and bending moment diagram. Sway analysis of rigid jointed rectangular (single storey) portal frames using slope-deflection method.

UNIT - 2 (16 Hours)

Moment Distribution Method of Analysis: Stiffness factor, Carry over factor, Distribution factor, Application to beams with and without joint translation, Yielding of support, application to non-sway rigid jointed rectangular portal frames, Shear force and bending moment diagram. Sway analysis of rigid jointed rectangular single bay single

storey portal frames using moment distribution method. Analysis of building members, Frames with various load combinations, Substitute frames, Use of half stiffness method. Basics of Moment redistribution concept.

UNIT - 3 (16 Hours)

Fundamental Concepts of Flexibility and Stiffness Method of Analysis: Formulation of flexibility matrix, Application of flexibility method to beams and rigid jointed rectangular portal frames. Formulation of stiffness matrix, Application to rigid jointed rectangular portal frames by structure approach only. Half stiffness method.

UNIT - 4 (16 Hours)

Kani's Method of Rotation Contribution: Basic concepts, Rotation contribution, rotation factor, Application to continuous beams, Portal frames and Multistoried frames with lateral loads (Wind and Earthquake). Support settlement. Analysis of building frames with various load combinations, Half rotation contribution method.

Approximate Analysis of Multistoried Frames: Portal frame method**,** Cantilever method.

Recommended Reading:

1. S. S. Bhavikatti; Structural Analysis Volume-I and Volume II; Vikas Publications.
2. Vazrani and Ratwani; Analysis of Structures; Khanna Publications.
3. C. S. Reddy; Basic Structural Analysis; Tata McGraw Hill.
4. C. K. Wang; Indeterminate Structural Analysis; McGraw Hill Book Company.
5. R. C. Hibbeler; Structural Analysis; Pearson Education Asia publication.
6. Devdas Menon; Structural Analysis; Narosa Publishing House,
7. Pandit and Gupta; Structural Analysis; Tata McGraw Hill, Pub. Co.Ltd .

Tutorial Exercise:

- The exercises shall include assignments based on above syllabus to be completed during Tutorial class.
- The tutorials should also include analysis of continuous beams/portal frames/using excel sheets/structural analysis software's.

CE 5.2 DESIGN OF CONCRETE STRUCTURES - I

Subject Code	Nomenclature of the Subject	Scheme of Instruction Hrs/Week			Scheme of Instruction						
		L	T	P	Th. Duration (Hrs)	Marks					
						TH	S	TW	P	O	Total
CE 5.2	Design of Concrete Structures - I	4	1	--	3	100	25	--	--	--	**125**

Course Objectives:

1. To impart the knowledge of structural design of a reinforced concrete structure using working stress method.
2. To learn to design water tanks using Working stress method.
3. To learn the concepts of Pre stressing.
4. To impart the knowledge of yield line theory.

Course Outcomes:

The student after undergoing this course will be able to:

1. Interpret Codal Provisions.
2. Design RCC beams and water tanks using Working Stress method.
3. Detail the reinforcement as per the design.
4. To understand the principles involved in analysis and design of Pre-stressed concrete structures.
5. Understand the concept of yield line theory.

UNIT - 1 (16 Hours)

Working Stress Method: Introduction, assumptions, Fundamentals, Moment of resistance of singly reinforced rectangular R.C. sections, Under reinforced, Balanced and Over reinforced sections and related problems. Doubly reinforced sections, Concept of steel beam theory.

UNIT - 2 (16 Hours)

Design of Water Tanks: Introduction to rectangular water tanks resting on ground, Underground and Overhead tanks. Design of circular tanks resting on ground. Staging analysis. Related numericals.

UNIT - 3 (16 Hours)

Pre-Stressed Concrete: Concept of pre-stressing, Materials used, Analysis of sections, Methods of pre-stressing, Load balancing concept. Losses of pre-stress. Design of simply supported pre-stressed member. Numericals on losses and stress/load concept.

UNIT - 4 (16 Hours)

Yield Line Analysis: Introduction, Basic concepts, Location of yield lines for standard cases for uniformly distributed and Point loads. Methods of analysis - virtual and equilibrium. Numerical examples on analysis and design of simple slab using yield line method

Recommended Readings:

1. B. C. Punmia, Ashok K. Jain, Arun K. Jain; Reinforced Concrete Structures; Laxmi Publications.
2. Ashok K. Jain; Reinforced Concrete, Limit State Design; Nem Chand and Bros.
3. S. N. Sinha; Reinforced Concrete Design; Tata McGraw-Hill Education.
4. N. Krishna Raju; Prestressed Concrete; Tata McGraw-Hill Education
5. A. H. Nilson; Design of Concrete Structures; McGraw Hill Publication.
6. IS Codes: IS 456, IS 875, IS 1343 and IS 3370.

Tutorial Exercise:

- Exercises shall include at least four assignments based on the above syllabus to be completed during Tutorial Class.

CE 5.3 DESIGN OF STEEL STRUCTURES - I

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Instruction						
		L	T	P	Th. Duration (Hrs)	Marks					
						TH	S	TW	P	O	Total
CE 5.3	Design of Steel Structures - I	4	--	--	3	100	25	--	--	--	**125**

Course Objectives:

1. To introduce the theory and applications in designing of steel structures.
2. To develop an understanding of the behavior and design of steel members and systems.
3. To equip the students with the tools necessary for designing steel structures and to familiarize them with relevant design codes.

Course Outcomes:

The student after undergoing this course will be able to:

1. Design the various structural steel members and connections.
2. Apply the principles, procedures and Codal requirements to the analysis and design of tension members, compression members, bases, beams, and connections.
3. Familiarize with the latest development in steel structures.

UNIT - 1 (16 Hours)

Introduction: Merits and demerits of steel, Cold formed sections, Rolled steel sections, Loads and loading combinations, Permissible stresses, Partial safety factors, Design methods.

Bolted Connections: Introduction, Advantages/ Disadvantages, Types of bolts, Types of bolted connections, Design of bolted shear connections, Bolts subjected to tension, Bolted connections subjected to combined shear and moment and shear and tension.

Welded Connections: Introduction, Types of welds, Types of welded joints, Permissible stresses, Design of fillet welds for axial loads and Eccentric loads, Unstiffened seat connections, Butt welds, Design of axially and Eccentrically loaded butt welds.

UNIT - 2 (16 Hours)

Design of Tension Members: Introduction, Permissible stresses, Net sectional areas, Design of axially loaded tension members, Design of tension members subjected to both axial tension and bending.

Design of Compression Members: Introduction, Effective length of columns, Slenderness ratio, Design of axially loaded compression members, Beam column, Design of eccentrically loaded compression members, Column splicing, Design of angle struts.

UNIT - 3 (16 Hours)

Design of Built - up Compression Members with Lacings and Battens.

Design of Column Bases: Introduction, Design of slab base and Gusseted base, Column bases subjected to moments.

UNIT - 4 (16 Hours)

Design of Beams: Introduction, Permissible stresses in bending, shear, Bearing, Deflection, Web crippling, Web buckling, Lateral stability of beams, Design of laterally supported beams, Design of laterally unsupported beams.

Built - Up Beams: Design of plated built-up beams, Check for bending stress, Shear stress, Deflection, Curtailment of cover plates. Box sections.

Recommended readings:

1. N. Subramanian; Design of Steel Structures; Oxford University Press.
2. S. K. Duggal; Limit State Design of Steel Structures; Tata McGraw hill.
3. M. L. Gambhir; Fundamentals of Structural Steel Design; Tata McGraw hill.
4. S. S. Bhavikatti; Design of Steel Structures; I. K. International publishing house.
5. V. L. Shah and Veena Gore; Limit State Design of Steel Structures; Structures publications.
6. M. R. Shiyekar; Limit State design in Structural Steel; Prentice Hill of India.
7. IS 800-2007 - General construction in Steel Code of Practice.
8. IS 875-1987 (Part 1, 2, 3)
9. Steel Tables.

CE 5.4 GEOTECHNICAL ENGINEERING - I

Subject Code	Nomenclature of the Subject	Scheme of Instruction Hrs/Week			Scheme of Instruction						
					Th. Duration (Hrs)	Marks					
		L	T	P		TH	S	TW	P	O	Total
CE 5.4	Geotechnical Engineering - I	3	--	2	3	100	25	--	25	--	**150**

Course Objectives:

1. To acquaint the students with "soil" as an engineering material.
2. To understand stresses and stress conditions, factors affecting soil strength and stress-strain behavior of soil.
3. To understand Seepage through soils, deformation and settlement characteristics of soils.
4. To understand lateral earth pressure of soil on earth retaining structures and bearing capacity of soil.

Course Outcomes:

The student after undergoing this course will be able to:

1. Understand soil as an engineering material.
2. Determine the, classify and characterize the soil.
3. Determine the index properties, shear strength of soils and bearing capacity of soils.
4. Estimate lateral earth pressure on retaining walls.

UNIT - 1 (12 Hours)

Origin of Soil and its Properties: Origin of soil, Introduction, Soil as three phase system, Index properties; Specific gravity, Porosity, Void ratio, Density, Unit weight, Moisture content etc. Weight volume relationship, Different forms of soil moistures, Plasticity characteristics of soil, Plasticity of soil, Consistency limits-liquid limit, Plastic limit, Shrinkage limit, Plasticity, Liquidity and consistency index, Flow and Toughness index, Definitions of activity and Sensitivity, Determination of: Liquid limit, Plastic limit and Shrinkage limit and their applications. Classification of soils, Particle size classification, Textural classification, Unified soil classification, Indian standard soil classification system, Field identification of soils, General characteristics of soil in different groups.

UNIT - 2 (12 Hours)

Soil Exploration and Sampling: General planning, Site exploration, Methods of site exploration - Standard penetration test, Cone penetration test, Wash boring and Rotary drilling, Bore logs. Disturbed and Undisturbed soil samples and types of samplers.

Shear Strength: Concept of shear strength, Principal stresses, Mohr's circle, Mohr - Coulomb shear strength theories. Laboratory determination of shear strength by Unconfined compression test, Direct shear test, Vane shear test and Triaxial shear tests (UU, CU and CD), Application of shear strength parameters in field. Skempton's pore pressure coefficients. Concept of total stress and effective stress. Introduction to liquefaction/ quicksand condition. Thixotropy, Sensitivity

UNIT - 3 (12 Hours)

Compaction of Soil: Introduction, Theory of compaction, Laboratory determination of optimum moisture content and maximum dry density- Standard Proctor test and Modified Proctor test, Zero air-voids line, Factors affecting compaction. Compaction in field, Compaction specifications and Field control.

Consolidation of Soil: Introduction, Comparison between compaction and consolidation, Initial, Primary and Secondary consolidation, Spring analogy for primary consolidation, Coefficient of consolidation from laboratory test results, Basic definitions, Terzaghi's theory of consolidation, Final settlement of soil deposits, Consolidation settlement: One-dimensional method, Secondary consolidation. Sand drains and Pre-Fabricated vertical drains.

UNIT - 4 (12 Hours)

Permeability of Soil: Introduction to hydraulic head, Darcy's law, Validity of Darcy's law. Determination of coefficient of permeability: Laboratory method: Constant head method, Falling head method. Field method: Pumping-in test, Pumping-out test. Permeability aspects: Permeability of stratified soils, Factors affecting permeability of soil. Seepage analysis-Introduction, Stream and Potential functions, Characteristics of flow nets, Graphical method to plot flow nets.

Earth Pressure: Concept of earth pressure, Relation of deformation and Earth pressure, active, Passive and at rest conditions, Conjugate stresses, Rankine and Coulomb's earth pressure theories. Graphical solutions - Trial wedge method. Critical depth of open cut in cohesive soil. Introduction to basics of soil nailing, Gabions and Reinforced earth.

Recommended Readings:

1. B. C. Punmia; Soil Mechanics Foundations; Laxmi publications pvt. Ltd.
2. Alam Singh; Modern Geotechnical Engineering; CBS Publishers and distributors.
3. Muni Budhu; Soil Mechanics and Foundations; John Wiley and sons.
4. J. E. Bowles; Foundation Analysis and Design; McGraw Hill Pub. Co., New York.

5. Karl Terzaghi; Soil Mechanics in Engineering Practice; Warren Press.
6. M. D. Bolton; Guide to Soil Mechanics; Universities Press.
7. Braja M. Das; Principles of Geotechnical Engineering; Cengage learning.
8. Ranjan, Gopal and Rao; Basic and Applied Soil Mechanics; New Age Int. Pvt. Ltd.,
9. IS Codes: IS 1080, IS 1892, IS 2132, IS 2720, IS 2809 and IS 4464.

List of Experiments:

(At least 8 experiments should be conducted from the list of experiments)

1. To determine field density by using:
    a. Core- Cutter Method
    b. Sand Replacement Method and to determine voids ratio of soil
2. To determine consistency limits of soil (a) Liquid limit (b) Plastic limit and (c) Shrinkage limit.
3. To determine of grain size distribution of soil by:
    a. Wet sieve analysis
    b. Sedimentation analysis by pipette analysis/ hydrometer
4. To determine compaction characteristics of soil using Standard and Modified Proctors test.
5. To determine shear strength of soil by using Direct Shear test
6. To determine shear strength of soil by using Unconfined Compression test
7. To determine shear strength of soil by using Triaxial test
8. To determine shear strength of soil by using Vane Shear test
9. To determine coefficient of permeability of soil.
10. To determine consolidation characteristics of soil.
11. To determine relative density of soil.

CE 5.5 TRANSPORTATION ENGINEERING – I

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
						Marks					
		L	T	P	Th Duration (Hrs)	Th.	S	TW	P	O	Total
CE 5.5	Transportation Engineering - I	3	--	2	3	100	25	--	25	--	**150**

Course Objectives:

1. To introduce principles and practice of transportation engineering.
2. To impart analytical knowledge of highway cross section elements, alignment and intersections.
3. To know the principles of geometric design for various transportation facilities.
4. To learn about various characteristics, testing methods, and standard specification of different highway materials considering the serviceability requirements of pavements.

Course Outcomes:

The student after undergoing this course will be able to:

1. Apply knowledge of transport planning.
2. Apply the construction and maintenance aspects of roads
3. Know the usage of signs, road markings and other elements.
4. Gain an in depth knowledge of modern trends in pavements construction.

UNIT - 1 (12 Hours)

Highway Development and Planning : Importance of Transportation, Classification of roads, Road patterns, Highway Planning; Necessity of highway planning, Need for Highway alignment; Factors controlling alignment, Planning surveys, Preparation of plans, Interpretation of planning surveys, Preparation of master plan, Highway planning and Development in India, Preparation of detailed project reports, Environment impact assessment.

Highway Cross Section Elements : Carriageway, Shoulders, Formation, Road Margins, Width of roadway, Right of way; Kerbs, Foot paths, Medians service ducts - Design specifications; Pavement Surface characteristics; Skid resistance, Factors affecting skid resistance, Measurement of skid resistance; Road roughness, Measurement of road roughness; Camber, Objectives of camber, Design standards. Typical cross section of road –cuttings, Embankment, Hilly areas, 6 lane expressway, Divided highway.

UNIT - 2 (12 Hours)

Geometric Design of Road: Factors influencing geometric design elements, Types of sight distances and Significance, Analysis of sight distances.

Horizontal Alignment: Requirements, Super elevation, Methods of attainment of super elevation, Extra widening of curves, Transition curves, Types, Length of transition curve.

Vertical Alignment: Types of gradients, Grade compensation on curves, Vertical curves

Intersections: Types, At-grade Intersections, Channelization, Objectives; Traffic islands.

Rotary Intersection: Concept, Advantages and Disadvantages; Grade separated interchanges, Types.

Pavement Materials: Desirable properties and Testing of pavement materials, Road aggregates, Bituminous materials and Subgrade soil.

Interlocking Concrete Block Pavement: Scope and Applications, Types, Composition and Geometry of blocks; Application in foot paths and Roads.

UNIT - 3 (12 Hours)

Design, Construction and Maintenance: Types of pavements and its components, Factors influencing the design of pavements, Wheel load applications, Pavements design traffic, Subgrade strength and Characteristics.

Design of Flexible Pavements: Methods, IRC guidelines, CBR method of design, Group index method.

Design of Rigid Pavements: Factors affecting design, Stresses in rigid pavements, IRC method of design, Joints in Rigid pavements, Design of joints, Brief study of failures in flexible and Rigid pavements and Maintenance, Strengthening of existing pavements, Overlays, Worked out problems.

Construction of Roads: Bituminous concrete, Cement concrete, Cement stabilized roads, Brief study of types and Uses of failures in flexible and Rigid pavements and Maintenance, Strengthening of existing pavements, Modern methods of road construction.

UNIT - 4 (12 Hours)

Traffic Engineering: Traffic: Characteristics, Speed, Journey time and Delays, Vehicle volume counts, Origin and Destination, Analysis and Interpretation of survey data, Traffic operations, Traffic signals, Parking space, Highway lighting, Planning and Administration, Road accidents and Safety measures, Road signage, Road safety audit.

Highway Drainage: Introduction, Importance of highway drainage, Surface drainage, Subsurface drainage, Drainage of slopes and Erosion control, New methods and Concepts in highway drainage, Types of cross drainage structures, Road construction in water logged areas.

Recommended Readings:

1. C. E. G. Justo and S. K. Khanna; Highway Engineering; Nem Chand and Brothers.
2. L. R. Kadiyali; Highway Engineering; Khanna Publishers, New Delhi.
3. Subhash C. Saxena; Highway and Traffic Engineering; CBS publishers and distributors New Delhi.
4. James H. Banks; Transportation Engineering; Mc. Graw. Hill Pub. New Delhi.
5. Animesh Das; Principles of Transportation; Prentice Hall India Publications.
6. Ministry of Road Transport and Highway; Specifications for Roads and Bridges, IRC, New Delhi.
7. K. P. Subramanium; Transportation Engineering; Scitech Publications, Chennai.
8. IRC 104: Guidelines for Environmental Impact Assessment of Highway.
9. IRC SP: 63-2004 "Guidelines for Use of Interlocking Concrete Block Pavement", Indian Roads Congress.

List of Experiments:

(At least 8 experiments should be conducted from the list of experiments.)

1. To determine Grain size analysis of fine and coarse aggregates.
2. To determine flakiness and elongation Index of aggregates.
3. To determine Los Angeles Abrasion value.
4. To determine Impact value for Aggregates.
5. To determine Crushing value for aggregates.
6. To determine the softening point of Bitumen.
7. To determine ductility value of bitumen.
8. To determine Penetration test for Bitumen.
9. To determine Bitumen content in the given mix.
10. To determine the Marshall stability value of the given mix.

CE 5.6 BUILDING DRAWING - II

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
						Marks					
		L	T	P	Th Duration (Hrs)	Th.	S	TW	P	O	Total
CE 5.6	Building Drawing - II	3	--	3	4	100	25	25	--	--	**150**

Course Objectives:

1. To Visualize, sketch and accurately draw the components inorder to communicate information to specific audiences.
2. To interpret, design, produce and evaluate a variety of graphical presentations using a range of manual based techniques.
3. To know various rules and regulations of planning pertaining to Public Buildings.
4. To use software like Auto-CAD in drafting.

Course Outcomes:

The student after undergoing this course will be able to:

1. Understand the building bye laws.
2. Generate plan, elevation and section of any public building.
3. Read and understand the complete architectural drawing.
4. Learn usage of Auto-CAD for various architectural drawing.

UNIT - 1 (12 Hours)

Introduction to Public Accommodation Systems: General requirements, Necessary and minimum requirements of public accommodations. Zoning and Design aspects. PDA regulations with reference to public buildings, Barrier free environment, Lighting and Ventilation, Concept of green building design.

UNIT - 2 (12 Hours)

Design of Buildings for Education: Schools, Colleges, Training centers, Libraries and Hostels. (Generation of Main Plan, Line Plan and Perspective drawing)

UNIT - 3 (12 Hours)

Design of Commercial Buildings: Office buildings, Factories, Ware house and Terminal facilities. (Generation of Main Plan, Line Plan and Perspective drawing)

UNIT - 4 (12 Hours)

Design of Buildings for Recreation and Health: Hospitals, Hotels, Theaters, Parks Amusement centers, Sports facilities and Rest houses. (Generation of Main Plan, Line Plan and Perspective drawing)

Recommended Readings:

1. M. G. Shah, C. M. Kale and S. Y. Patki; Building Drawing; Tata McGraw Hill Publication.
2. Y. S. Sane; Planning, designing building; Allies Book Stall.
3. S. V. Deodhar; Building Science and Planning; Khanna Publication.
4. George Omura; Mastering Auto CAD 2014; Wiley Publication.
5. S. S. Bhavikatti and M. V. Chitawadagi; Building Planning and Drawing; I K International Publishing House.
6. PDA Regulations Handbook published by the State Government.

Term Work:

(**The term work shall be completed during practical hours and marks to be awarded based on the assessment of drawing sheets**)

The term work shall include:

1. At least one detailed sheet on Unit 2, 3, and 4. Each sheet shall accompany with a detailed report of area statements and other stipulations specified in PDA rules.
2. Any one sheet mentioned at serial number 1 above, to be done using AutoCAD.
3. One sheet of perspective drawing on any one Unit 2, 3, or 4.
4. Possible one sheet of line plan on any one Unit 2, 3, or 4.

CE 6.1 DESIGN OF CONCRETE STRUCTURES - II

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Instruction						
		L	T	P	Th. Duration (Hrs)	Marks					
						TH	S	TW	P	O	Total
CE 6.1	Design of Concrete Structures - II	4	1	--	3	100	25	--	--	25	**150**

Course Objectives:

1. To introduce to students the theory and application of analysis and design of reinforced concrete structures using Limit state method.
2. To make the students understand the designing concepts of various components of a building.
3. To prepare students for the effective use of the latest design aids and computer software in the design of reinforced concrete members.

Course Outcomes:

The student after undergoing this course will be able to:

1. Recognize the design philosophy of reinforced concrete structures.
2. Apply the principles, procedures and current code requirements to the analysis and design of reinforced concrete beams, slabs, columns and footings.
3. Detail the reinforcement as per the design.
4. Apply techniques and computer software to analyze reinforced concrete structural systems.

UNIT - 1 (16 Hours)

Limit State Method: Limit state of collapse, Limit state of serviceability and Limit state of durability. Characteristic strength, Characteristic load, Partial safety factors for material strengths and Loads. Assumptions of limit state method, Strain and Stress variation diagram.

Analysis and Design of Singly Reinforced Beams: Analysis of singly reinforced RC section, Neutral axis, Balanced and Under-reinforced sections. Moment of resistance, Design parameters, Design examples.

Analysis and Design of Doubly Reinforced Beams: Necessity of doubly reinforced sections, Analysis of doubly reinforced RC Section, Moment of resistance, Design parameters, Design examples.

Shear and Bond Design of RCC: Design of vertical stirrups, Bent - up bars, Limitation, Bond failure in RC, Check for bond resistance, Development length, Design for shear and bond.

Design for Torsion: Design Concept, Different types of failures in structural components due to torsion.

UNIT - 2 (16 Hours)

Analysis and Design of Beams: Analysis and design of singly, doubly and flanged sections. Numericals on analysis and design.

UNIT - 3 (16 Hours)

Design of RCC Slabs: Design of one way slabs and two way slabs.

UNIT - 4 (16 Hours)

Design of Column: Introduction, Concepts of short and long columns, IS requirements, Concept of helical reinforcements. Design of axially loaded columns.

Design of Footing: Design of isolated Square, Rectangular and Circular column footing for axial load only.

Recommended Readings:

1. B. C. Punmia, Ashok Kumar Jain, Arun Kumar Jain; Limit State of Reinforced Concrete Structures; Laxmi Publications.
2. Ashok K. Jain; Reinforced Concrete, Limit State Design; Nem Chand and Bros.
3. S. Pillai, Devdas Menon; Reinforced Concrete Design; Tata McGraw Hill.
4. S. N. Sinha; Reinforced Concrete Design; Tata Mcgraw Hill .
5. V. L. Shah, S. R. Karve; Illustrated Design Reinforced Concrete Buildings (Design of G+3 Storeyed buildings + Earthquake analysis and Design); Structures Publications.
6. IS Codes: IS 456, IS 875 and IS 1893.

Tutorial Exercise:

- Tutorial class shall include at least four assignment based on above syllabus.
- Design of RCC slab/beam/column/footing using EXCEL spread sheet
- Introduction to any design software such as ETABS/SAP2000/MIDAS-GEN

CE 6.2 DESIGN OF STEEL STRUCTURES - II

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Instruction						
		L	T	P	Th. Duration (Hrs)	Marks					
						TH	S	TW	P	O	Total
CE 6.2	Design of steel Structures - II	3	--	2	3	100	25	25	--	--	**150**

Course Objectives:

1. To analyse and design residential and industrial building components like roof truss, plate girder and Gantry girder.
2. To apply theory of structural plastic analysis to determine collapse load of steel members.

Course Outcomes:

The student after undergoing this course will be able to:

1. Design roof trusses, plate girders and gantry girder.
2. Carry out the plastic analysis and design.

UNIT - 1 (12 Hours)

Design of Roof Trusses: Introduction, Types of roof trusses, Components of roof trusses, Roof coverings, Loads and Load combinations, Design of roof truss members, Design of purlins, Lateral bracing of trusses, Design of hinged and Sliding support connections.

UNIT - 2 (12 Hours)

Design of Plate Girders: Introduction, Elements of plate girder, Design members, Economic depth and Self-weight, Design of web plate, Design of flanges, Curtailment of flange plates, Connection of flange angles to web, Connection of flange angles to cover plates, Intermediate vertical stiffeners, Horizontal stiffeners, Bearing stiffeners, Web splice, Flange splice, Design of bolted / Welded plate girders.

UNIT - 3 (12 Hours)

Plastic Analysis and Design: Introduction, Ultimate load carrying capacity of members

in axial tension and Compression, Plastic bending of beams, Plastic moment, Shape factor, Plastic hinge, Load factor, Conditions and Basic theorems of plastic analysis, Determination of collapse load for beams and portal frames, Design recommendations, Limitations of plastic analysis.

UNIT - 4 **(12 Hours)**

Gantry Girders: Introduction, Permissible stresses, Loads acting on gantry girders, Types of gantry girders, Crane rails, Crane data, Maximum moments and Shears, Design of gantry girders.

Recommended Readings:

1. N. Subramanian; Design of Steel Structures; Oxford University Press.
2. S. T. K. Duggal; Limit State Design of Steel Structures; Tata McGraw hill.
3. M. L. Gambhir; Fundamentals of Structural Steel Design; Tata McGraw hill.
4. S. Bhavikatti; Design of Steel Structures; I. K. International Publishing House.
5. V. L. Shah and Veena Gore; Limit State Design of Steel Structures; Structures Publications.
6. M. R. Shiyekar; Limit State Design in Structural Steel; Prentice Hill of India.
7. IS 800 and IS 875 (Part 1, 2, 3).
8. Steel Tables.

Term Work:

(The term work shall be completed during practical hours and marks to be awarded based on the assessment of assignments conducted)

1. Design of steel beams, columns and foundations using spreadsheets.
2. Analysis and design of steel beams, columns, foundations, steel floor grids and portal frames, steel truss using software.
3. Atleast 3 assignments based on the above syllabus.

CE 6.3 GEOTECHNICAL ENGINEERING – II

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Instruction						
		L	T	P	Th. Duration (Hrs)	Marks					
						TH	S	TW	P	O	Total
CE 6.3	Geotechnical Engineering - II	4	1	--	3	100	25	--	--	--	**125**

Course Objectives:

1. To evaluate stability of natural slopes and man-made deposits.
2. To design different types of foundations and earthworks.
3. To understand stresses and stress conditions in soil.
4. To understand deformation and settlement characteristics of soils.
5. To understand the behavior of pile and well foundations.

Course Outcomes:

The student after undergoing this course will be able to:

1. Determine Soil stress distribution and settlement.
2. Perform Soil slope stability analysis.
3. Compute bearing capacity of different types of soils.
4. Analyze behavior of pile foundations, well foundations under given loads.

UNIT - 1 (16 Hours)

Stress Distribution: Introduction, Boussinesq Equation, Stress distribution due to concentrated load, Pressure distribution, Boussinesq stress distribution due line load, Strip load, Uniformly loaded circular area and Rectangular area, Newmark's influence chart, Westergaard's analysis; Basic concepts.

Stability of Slopes: Concept of limit, Equilibrium method, Stability of slopes; Introduction, Different factors of safety, Types of slope failures, Analysis of finite and Infinite slopes, Wedge failure swedish circle method, Friction circle method, Method of slices for c-Φ soil, Stability numbers and Charts, Taylor's Stability number and Stability curves, Bishops method of slices.

UNIT - 2 (16 Hours)

Bearing Capacity: Definition, General shear and Local shear failure, Terzaghi bearing capacity equation for shallow foundation, Effect of water table on bearing capacity, Bearing capacity for layered soils, IS Code method of determination of bearing capacity,

Factors influencing bearing capacity, Introduction to Meyerhof's bearing capacity theory, Use of plate load test, Pressure-meter test and SPT and CPT in assessing safe bearing capacity. Calculation of bearing capacity using bore log data - a case study.

UNIT - 3 (16 Hours)

Settlement Analysis: Definition, Types of settlements, Computations based on theory and Test results, Effect of width and Depth of foundation, Construction time settlement, Components of settlements and their estimation, Allowable settlement values, Effects, Causes and Remedial measures of total and Differential settlements, Permissible settlements as per I.S.

Shallow Foundation: Types of foundations and Choice, Basic requirements, Minimum depth of foundation, Contact pressure distribution, Isolated square and Rectangular footing, Combined rectangular, Trapezoidal and Strap footing and Raft foundation. Pressure distribution below mat foundation

UNIT - 4 (16 Hours)

Pile Foundation: Classification and uses, Load carrying capacity calculations of single pile by different methods, Static and Dynamic approach, In-situ penetration tests, Pile load tests, Initial and Routine, Negative skin friction, Under-reamed pile foundations; Pile groups, Necessity, E-Efficiency, Group capacity and Settlements.

Caisson: Introduction, Shapes of wells and Component parts, Forces acting on well foundation, Grip length and Scouring depth, Bearing capacity of well foundation, Well curb, Cutting edge, Steining and Bottom plug, Well sinking and Remedial measures for tilts and Pneumatic caissons.

Recommended Readings:

1. B. C. Punmia; Soil Mechanics Foundations; Laxmi publications, Pvt. Ltd.
2. Alam Singh; Modern Geotechnical Engineering; CBS Publishers and distributors.
3. S. P. Brahma; Foundation Engineering; Tata McGraw Hill.
4. Swami Saran; Design of Sub-Structures; CRC press.
5. Bowles J. E.; Foundation Analysis and Design; McGraw Hill Pub. Co., New York.
6. Craig R. F.; Soil Mechanics; Chapman and Hall.
7. Purshottam and Raj; Soil Mechanics and Foundation; Pearson Education.
8. Braja M. Das; Shallow Foundations; CRC press.

9. IS Codes: IS 1904, IS 6403, IS 8009, IS 2950: Part I, IS 9214, IS 4968: Part III, IS 1080, IS 2131, IS 1888 and IS 2911: Part I to IV.

Tutorial Exercise:

- Tutorial classes shall include at least four assignments based on above syllabus.
- Analysis of Geotechnical Problems using software's.

CE 6.4 TRANSPORTATION ENGINEERING – II

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Instruction						
		L	T	P	Th. Duration (Hrs)	Marks					
						TH	S	TW	P	O	Total
CE 6.4	Transportation Engineering - II	3	1	--	3	100	25	--	--	--	**125**

Course Objectives:

1. To impart in-depth knowledge about the aircraft characteristics, planning and airport components.
2. To know the basics and design of various components of railway engineering.
3. To impart knowledge about methods of tunnelling.
4. To study the types and components of docks and harbours.

Course Outcomes:

The student after completion of this course will be able to:

1. Gain in depth knowledge of airport engineering.
2. Understand construction, maintenance and geometrical design of railway track.
3. Understand construction and maintenance of tunnels, docks and harbours.

UNIT - 1 (12 Hours)

Airport Engineering: Airport Planning and design, Layout of an airport with component parts and Functions, Site selection for airport, Aircraft characteristics affecting the design and Planning of airport, Airport classification, Runway orientation using wind rose with examples, Basic runway length, Corrections and Examples, Runway geometrics and Design, Runway safety . Taxiway Design, Factors affecting the layout, Geometrics of taxiway, Visual aids, Airport marking, Lighting, Air traffic control, Instrumental landing system.

UNIT - 2 (12 Hours)

Railway Engineering: Importance of railways in national development, Factors controlling alignment, Engineering surveys for track alignment, Typical cross sections for single and Double line tracks, Gauges, Coning of wheels and Tilting of rails, Rails, Functions and requirements of component parts of railway track, Creep of rails. Sleepers; Functions and Types, Ballast; Properties, Subgrade and Formation, Geometrical design of railway track, Horizontal curves, Super elevation, Points and Crossings, Track junctions and Simple track layouts, Transition curves, Safe speed on curves, Different types of

gradients, Grade compensation. Modern welded railway track, Signalling and Interlocking, Railway stations and Yards, Modernization of railways, High speed trains, Ballast-less tracks.

Railway Construction and Maintenance: Construction of railway track, Earthwork, Plate laying and Packing, Maintenance of track alignment, Gauge, Renewal of component parts and Drainage, Modern methods of track maintenance.

UNIT - 3 (12 Hours)

Tunnelling: Tunnel alignment and Grade-size and Shape of tunnel, Methods of tunnelling in different types of rocks, Ventilation, Lining, Drainage and Lighting of tunnels, Excavation machines, Methods of excavation, Factors influencing machine performance, Indexing methods for rock excavation, Influence of Rock Mass properties on TBM. Indian scenario on TBM, Shotcreting – NATM, Purpose of shotcrete, Dry and Wet processes, Steel fibre reinforced shotcrete.

UNIT - 4 (12 Hours)

Docks and Harbours : Classification of harbours, Components, Site selection, Construction and Maintenance of wet and dry docks, Breakwaters, Lock gates, Quays, Jetties, Landing piers, Fenders, Dolphins, Slipways, Aprons, Transit sheds, Ware houses, Navigational aids such as light house, Buoys, Beacons, Study of important harbours, Objectives of dredging, Dredging equipments, Types of dredging in different soil conditions.

Recommended Readings:

1. Khanna, Arora and Jain; Airport Planning and Design; Nem Chand Bros, Roorkee.
2. Horenjeff and McKelvey; Planning and Design of Airports; McGraw Hill Company, New York.
3. Satish Chandra, M. M. Agarwal; Railway Engineering; Oxford University Press, New Delhi.
4. R. Srinivasan; Harbour; Dock and Tunnel Engineering; Charotar Publishing House
5. M. M. Agarwal; Indian Railway Track; Jaico Publications, Bombay.
6. J. S. Mundrey; Railway; Track Engineering; Tata McGraw Hill, New Delhi.
7. M. M. Agrawal; Railway Engineering; Prabha and Co., Delhi.
8. Saxena and Arora; Railway Engineering; Dhanpat Rai and Sons, New Delhi.

9. H. P. Oza and G. H. Oza; Docks and Harbour Engineering; Charaotar Publishing House.
10. T. Ramamurthy; Engineering in Rocks for Slopes, Foundations and Tunnels; PHI Learning.

Tutorial Exercise:

- The exercises shall include assignments based on above syllabus to be completed during Tutorial class.

CE 6.5 ENVIRONMENT ENGINEERING - I

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Instruction						
		L	T	P	Th. Duration (Hrs)	Marks					
						TH	S	TW	P	O	Total
CE 6.5	Environment Engineering - I	3	1	2	3	100	25	--	25	--	**150**

Course Objectives:

1. To impart knowledge of drinking water treatment and distribution in an integrated way, paying attention to the choice of technologies and tools, ranging from low-cost to advanced options.
2. To understand principles involved in the design and selection of appropriate unit processes.

Course Outcomes:

The student after undergoing this course will be able to:

1. Determine the quality of raw water and the degree of treatment required for public drinking purpose.
2. Calculate design specifications for unit processes to remediate water of a particular quality to a particular standard; select and design appropriate water treatment unit processes.
3. Plan and execute the plumbing and distribution system of water supply for a building.
4. Present the complete design of water supply scheme.

UNIT - 1 (12 Hours)

Introduction: Importance and Necessity of water supply scheme, Necessity of treatment, Sources of water (surface water and ground water sources).

Quantity of Water: Types of demand, Factors affecting per capita demand, Losses and Wastage, Population forecasting methods.

Intake Structures: Introduction, Types of intake structures, Design criteria.
Water Supply Schemes: Point of importance, Reports, Importance of water supply projects, Layout of water supply project.

UNIT - 2 (12 Hours)

Water Treatment Process: Necessity, Objectives of water treatment, Layout of a water treatment plant.

Water Quality: Critical water quality parameters and Specifications of drinking water (physical, chemical and bacteriological) by bureau of Indian standards and World health organization.

Unit Operations: Principle and Design of aeration systems.

Sedimentation: Process, Principles of sedimentation, Types of settling tank, Design criteria and Design of settling tanks.

Sedimentation with Coagulation: Types of coagulants, Optimum dosage of coagulant, feeding devices, Mixing devices.

UNIT - 3 (12 Hours)

Filtration: Theory, Classification of filters, Construction and Operation of filters and Numerical examples, Filter backwash, Under drainage systems, Operational problems and Trouble shooting, Pressure filters.

Disinfection of Water: Requirements of good disinfectant, Methods of disinfection.

Chlorination: Chemistry of chlorination, Methods of Chlorination.

Water Softening: Necessity of water softening, Removal of temporary hardness and Permanent hardness.

Miscellaneous Methods: Removal of iron and Manganese, Removal of color, Odor and Taste, Treatment with activated carbon, Desalination of Brackish water, Distillation - by oxidation of organic matter, Fluoridation and Defluoridation. Electrodialysis, Ion - exchange process, Reverse osmosis.

UNIT - 4 (12 Hours)

Water Supply in Rural Areas: Introduction; Source of water for small communities in rural areas; Selection of suitable source of water; Quantitative requirements of water in rural water supply schemes, Treatment for removing iron, Chlorinating small community supplies.

Distribution System: General Introduction, Requirement of a good distribution system, Arrangement of distribution pipes and other Accessories, Layout of distribution network, method of distribution, Pressure in the distribution system, Function of distribution reservoirs, Type of distribution reservoirs, Stand pipes, Storage capacity of distribution reservoirs, Location and Height of distribution reservoirs, Detection of leakage in the distribution pipes, Design of distribution system, Appurtenances in the distribution system.

Water Supply Plumbing System in Building and Houses: House water connection, Stop cock, Water taps and Bib cocks, Pipe fitting, Storage of water in buildings. Design consideration for water piping systems in building. Domestic hot water appliances, Solar water heater, Centralized hot water systems.

Recommended Readings:

1. Mark J. Hammer; Water and Waste Water Technology; Prentice Hall of India.
2. S. K. Garg; Water Supply Engineering; Khanna Publ.
3. B. C. Punmia, A. K. Jain; Water Supply Engineering; Laxmi Publication.
4. G. S. Birdie; Water Supply Engineering and Sanitary Engineering; Dhanpat Rai.
5. R. C. Rangwala; Water Supply Engineering, Charotar Publ. House.

List of Experiments:

At least 8 experiments should be conducted from the list of experiments.

1. Determination of solids (total, dissolved, suspended, organic, inorganic, settleable) in water
2. Determination of pH
3. Determination of turbidity
4. Determination of Alkalinity
5. Determination of total Hardness
6. Determination of Chlorides
7. Determination of optimum dosage of coagulant
8. Determination of dissolved oxygen content in water
9. Determination of Available chlorine on bleaching powder and test for residual chlorine
10. Determination of conductivity of water.

Tutorial Exercise:

- The exercises shall include assignments based on above syllabus to be completed during Tutorial class.
- Submission of field visit report to a water supply treatment plant.

CE 6.6 SURVEYING - II

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Instruction						
		L	T	P	Th. Duration (Hrs)	Marks					
						TH	S	TW	P	O	Total
CE 6.6	Surveying - II	3	--	2	3	100	25	--	25	--	**150**

Course Objectives:

1. To impart knowledge of Tacheometric surveying for distance and height measurement.
2. To understand the concept preliminary survey and its applications in setting out of curves, buildings, culverts and tunnels.
3. To understand the concept and application of surveying in triangulation and trigonometric leveling.
4. To get acquainted with advanced surveying techniques such as Remote Sensing, Total Station, GPS, etc.

Course Outcomes:

The student after undergoing this course will be able to:

1. Apply the measurement techniques and equipment used in land surveying.
2. Gain the ability to use modern survey equipment to measure angles and distances.
3. To understand the principles and operation of the global positioning system and remote sensing.
4. Draw and interpret contour plots.

UNIT - 1 (12 Hours)

Tacheometric Surveying: General principles of tacheometric systems, Tangential, Stadia and Subtense methods, Stadia systems, Horizontal and Inclined sights, Vertical and Normal staffing, Fixed and Movable hairs, Stadia constants, Analytic lens, Subtense bar, Reduction of tacheometric data, Use of tacheometric tables and Graphs, Error and Accuracy in tacheometry survey work, Numericals based on above concepts.

Setting Out Works: General horizontal and Vertical control, Setting out of foundation plan for load bearing and Framed structure, Batter board, Slope and Grade stakes, Setting out with theodolite. Setting out of sewer line, Culvert, Use of laser for works. Setting out center line for tunnel, Transfer of levels to underground work project / route survey for bridge, Dam And Canal. Checking verticality of high rise structures.

UNIT - 2 (12 Hours)

Curves: Definition, Degree of curve, Elements of simple curve, Setting out by linear method and Rankine's tangential method, Compound curves, Transition curves-elements and Setting out. Route surveying, Reconnaissance, Route surveys for highways, Railways and Waterways

Modern Surveying Instruments: Electronics in surveying, General principles used in the instruments. Auto levels, Self-compensating instrument, Digital level.

Introduction to Total Station: Field applications, Basic principle, Classifications, Electro-optical system, Measuring principle, Working principle, Sources of error, Infrared and Laser total station instruments. Care and Maintenance of total station instruments. Modern positioning systems, Traversing and Trilateration.

UNIT - 3 (12 Hours)

Remote Sensing: Electromagnetic remote sensing process. Physics of radiant Energy: Nature of electromagnetic radiation, Electromagnetic spectrum. Energy source and its characteristics. Atmospheric influences; Absorption, Scattering. Energy interaction with earth surfaces; Spectral reflectance curve. Image acquisition; Photographic sensors, Digital Data, Earth resource satellites, Image resolution. Image interpretation. Applications of Remote Sensing.

GPS Surveying: Basic concepts, Different segments , Space, Control and User segments , Satellite configuration, Signal structure, Orbit determination and Representation, Anti spoofing and Selective availability, Task of control segment, Hand held and Geodetic receivers, Data processing , Traversing and Triangulation.

UNIT - 4 (12 Hours)

Geodetic Surveying: Introduction to plane and Geodetic surveying, Fundamental principles, Earth ellipsoid, Geodetic datum and Coordinate systems.

Control Surveys - Horizontal and Vertical: Triangulation, Traverse, Levelling.

Instrumentation: Signals, Base line, Instruments and Accessories, Corrections, Satellite station, Reduction to centre. Sources, Precautions and Corrections, Errors, Classification of errors, True and most probable values, Weighted observations, Method of equal shifts, Principle of least squares; Normal equation, Correlates, Level nets, Adjustment of simple triangulation networks.

Recommended Readings:

1. A. Bannister and S. Raymond; Surveying; Elbs.
2. B. C. Punmia; Surveying, Vols. I, II; Laxmi Publications.
3. T. P. Kanetkar; Surveying And Levelling, Vols. I And II; United Book Corporation, Pune.
4. Alfred Leick; GPS Satellite Surveying; John Wiley and Sons Inc., 3rd Edition.
5. Satheesh Gopi, Rasathishkumar, N. Madhu; Advanced Surveying, Total Station GPS And Remote Sensing; Pearson Education.
6. D. Clark; Plane and Geodetic Surveying, Vols. I and II; C.B.S. Publishers and Distributors, Delhi, Sixth Edition.
7. S. Kumar; Basics of remote sensing and GIS; Laxmi Publications (P) Ltd.
8. Guha Pradeep Kumar; Remote Sensing for the Beginner; Affiliated East-West Press Pvt. Ltd.

List of Experiments:

(At least 8 experiments should be conducted from the list of experiments.)

1. To determine constants of tacheometer.
2. To determine the height and distance in tacheometric surveying.
3. To study satellite images and its interpretation in remote sensing.
4. To determine horizontal, sloping and vertical distances between any two points using total station
5. To set out a simple circular curve by any one linear method
6. To set out a simple circular curve by any one angular method.
7. To set out a simple foundation plan in the field.
8. To carry out contouring using radial method (project)
9. To use GPS in locating and obtaining time information in all weather conditions, anywhere on or near the Earth where there is an unobstructed line of sight to GPS satellites.
10. To determine the reduced levels using auto level.

CE 7.1 DESIGN OF CONCRETE STRUCTURES - III

Subject Code	Nomenclature of the Subject	Scheme of Instruction Hrs/Week			Scheme of Instruction						
		L	T	P	Th. Duration (Hrs)	Marks					
						TH	S	TW	P	O	Total
CE 7.1	Design of Concrete Structures - III	3	--	2	3	100	25	--	--	--	**125**

Course Objectives:

1. To impart the knowledge of structural design of a reinforced concrete structure using limit state method.
2. To apply the knowledge of designing for the various components of building.

Course Outcomes:

The student after undergoing this course will be able to:

1. Interpret Codal Provisions.
2. Design RCC slab, beams, columns, footings using limit state method.
3. Detail the reinforcement as per the design.

UNIT - 1 (12 Hours)

Design of Staircase: General features, Types of staircases, Design of Dog legged (longitudinally and transversely spanning), Quarter -turn and Open well staircase.

Design of Combined Footings: Rectangular and Trapezoidal footing.

UNIT -2 (12 Hours)

Design of Columns: Design of Long columns with axial load, Uniaxial and Biaxial bending.

Design of Multistoried Buildings: Design of all building components viz: Beams, Slabs, Columns, Footings and Staircases.

UNIT - 3 (12 Hours)

Redistribution of Moments: Concepts, Plastic hinge, Advantages and Analysis of portal frames. Design of grid floors and Flat slabs

UNIT - 4 (12 Hours)

Design of Retaining Wall: Cantilever and Counterfort**.**

Recommended Readings:

1. B. C. Punmia, Ashok Kumar Jain, Arun Kumar Jain; Limit State of Reinforced Concrete Structures; Laxmi Publications.
2. Ashok K. Jain; Reinforced Concrete, Limit State Design; Nem Chand and Bros.
3. S. U. Pillai, Devdas Menon; Reinforced Concrete Design; Tata McGraw Hill.
4. S. N. Sinha; Reinforced Concrete Design; Tata Mcgraw Hill.
5. V. L. Shah, S. R. Karve; Illustrated Design Reinforced Concrete Buildings; Structures Publications.
6. N. C. Sinha, S. K. Roy; Fundamentals of Reinforced Concrete; S Chand publication.
7. A. H. Nilson; Design of Concrete Structures; McGraw Hill Publication.
8. P. M. Fergusson; Fundamentals of Reinforced concrete Design; Willey Publication.
9. P. C. Varghese; Limit State Design of Reinforced Concrete; Prentice Hill India.
10. IS Codes: IS 456, IS 875, IS 1343, IS 3370 and IS 1893.

List of Experiments:

- Analysis, design and detailing of multistoried Building both manually and using software.
- A complete set of RCC drawings shall be prepared using AUTOCAD.

CE 7.2 ENVIRONMENT ENGINEERING - II

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Instruction						
					Th. Duration (Hrs)	Marks					
		L	T	P		TH	S	TW	P	O	Total
CE 7.2	Environment Engineering - II	3	1	2	3	100	25	--	25	--	**150**

Course objective:

1. To impart knowledge on basic concepts about sewerage system.
2. To make the student understand conveyance system of sewage.
3. To impart knowledge on primary, secondary and tertiary treatment of sewage.

Course outcome:

The student after undergoing this course will be able to:

1. Estimate sewage generation, understand the characteristics and composition of sewage.
2. Design the operation units and processes that are used in treatment of sewage.
3. Understand the self-purification of streams.
4. Understand the disposal methods for treated sewage and management of sludge.

UNIT - 1 (12 Hours)

Introduction: Definitions, Aim and Objective of sewage disposal. Methods of collection – conservancy system and Water carriage system. Sewerage Systems; Separate, Combined and Partially separate systems.

Quantity of Sanitary Sewage: Source, Factors affecting sanitary sewage, Variation in quantity of sanitary sewage, Peak flow and Minimum flow, Determination of flow velocity using empirical formulae.

Quantity of Storm Sewage: Factors affecting storm sewage, Quantity of storm water-rational method, Empirical formulae, Rainfall intensity curves.

UNIT - 2 (12 Hours)

Characteristics of Sewage: Physical, Chemical and Biological characteristics of sewage, sampling methods, Decomposition of sewage, Dissolved oxygen, Bio chemical oxygen demand, Expression for B.O.D and C.O.D.

Treatment of Sewage: Classification of treatment processes, Layout of treatment plants, Factors to be considered while designing a sewage treatment plant.

Physical Unit Operation: Design and Description of Screens, Grit chambers, Skimming tanks, Grease traps, Sedimentation tanks.

UNIT - 3 (12 Hours)

Biological Unit Process: Activated sludge process, its concepts, Design and Operation of aeration tanks, Types of aerators. Trickling filters, their classification, Geometry, Design and Operation, their operational difficulties and Remedies, Oxidation ponds, their classification, and Geometry \ Aerobic ponds. Lagoons, Oxidation ditches, SBR.

UNIT - 4 (12 Hours)

On- Site Sanitation: Septic tank, Imhoff tanks.

Sewage Disposal: Reuse of treated effluent, Disposal by dilution, Disposal on land, Water.

Sewer Appurtenances: Manholes, Drop manholes, Street inlets, Flushing tanks, Catch basin, Sand traps.

Recommended Readings:

1. S. K. Garg; Sewage and Waste Disposal Engineering; Khanna Publishers.
2. K. N. Duggal; Element of Environmental Engg.; S. Chand Publishing.
3. Metcalf and Eddy; Waste water Engineering; McGraw-Hill Education.
4. Ernest W. Steel; Water supply and Sewage; McGraw-Hill Education.
5. B. S. Raju; Water supply and Waste Water Engineering; Tata McGraw-Hill.

List of Experiments:

(At least 8 experiments should be conducted from the list of experiments.)

1. Determination of solids (total, dissolved, suspended, organic, inorganic, settleable) in water.
2. Determination of pH
3. Determination of turbidity
4. Determination of Acidity
5. Determination of Chlorides
6. Determination of Dissolved oxygen content in water
7. Determination of Biochemical Oxygen demand
8. Determination of Chemical Oxygen demand
9. Determination of sludge volume index of sewage sample.

Tutorial Exercise:

- The exercises shall include at least four assignments based on above syllabus to be completed during Tutorial class.
- Field visit report to any waste water treatment plant/Industry and submission of report.

CE 7.3 ESTIMATION, COSTING AND VALUATION

Subject Code	Nomenclature of the Subject	Scheme of Instruction Hrs/Week			Scheme of Instruction						
		L	T	P	Th. Duration (Hrs)	Marks					
						TH	S	TW	P	O	Total
CE 7.3	Estimation, Costing and Valuation	3	--	2	3	100	25	--	--	--	**125**

Course Objectives:

1. To acquire knowledge and skills in measurements of quantities, investigating factors affecting cost of an item of work, and preparing detailed estimates.
2. To gain general knowledge and awareness of valuation, functions of P.W.D. and office records.

Course Outcomes:

The student after undergoing this course will be able to:

1. Prepare detailed estimate of materials and abstract of costing in a residential building.
2. Prepare rate analysis of item of works in building estimate
3. Understand the tendering procedures and contracts in construction industry.

UNIT - 1 (12 hours)

Introduction: Definition of estimating and Costing, Purpose, Data required for preparing an estimate, Qualities of an ideal quantity surveyor.

Types of Estimates: Approximate or preliminary estimate, Detailed, Supplementary and Revised estimate with brief description of each. Purpose of approximate estimate and Methods of approximate estimation of a building and highway, Administrative approval, Expenditure sanction and Technical sanction.

Mode of Measurement: Standard unit of measurements, Modes of measurements for different items of work for buildings and Road work, Provision for lump sum, Spot item, and Provisional sums. Degree of accuracy in estimating; General rules for measurement of work as per IS 1200. Significance of provision for contingencies, Work charged establishment, Percentage provision for Water supply, Sanitation.

UNIT - 2 (12 hours)

Specification: Definition, purpose of specification, Types and principles of writing specification. Writing detailed specification for some common items of civil engineering works.

Detailed Estimate and Abstracting: Types of forms used for detailed measurement and Abstracting. Methods of taking out quantities; Centre line methods and Long wall and Short wall method. Case studies with different items for a single storied residential building including working out the percentage cost for different stages of construction.

Road Earth Work: Computation of earth work with no transverse slope using mean area and Mean depth formula including soling area for pitching/turfing. Estimate of a road with WBM and Bituminous road surface involving all basic items including computation of earth work, Quantities of carious items with abstract.

Preparation of brief report on estimate both for building and road.

UNIT - 3 (12 hours)

Bar Bending Schedule: Detail bar bending schedule with quantity of steel for slabs, Beams, Footings, Columns, Retaining wall.

Rate Analysis: Factors considered for rate analysis, Schedule of rates and Market rates for common materials and Capacity, Preparation of material estimate for common items of work. Rate analysis for common items of work (as specified in the term-work only).

UNIT - 4 (12 hours)

Valuation: Definition, Importance and Necessity of valuation, Factors affecting valuation, Methods of valuation, Book value, Market value, Single and Dual rates year's purchase, Depreciation, Sinking fund, Rent fixation, Valuation for various purposes, Numericals on valuation.

Tenders and Contracts: Definition and Purpose of tender; Salient features of processing tender. Definition of contract. Type of contracts; Salient features, Obligation of the parties to a contract. Earnest money deposit, Security deposit, Running account bill and Final bill.

Recommended Readings:

1. B. N. Datta; Estimation and Costing; S. Dutta and co., Lucknow.

2. M. Chakraborti, Estimation and Costing; M. Chakraborty Publ.
3. S. C. Rangawala; Elements of Estimation and Costing; Charotar Publishing House.
4. J. R. Mule; Valuation, Estimation and Costing; Charotar Publishing House.
5. G. S. Birdi, Text Book of Estimating; Dhanpatrai and Sons, Delhi.
6. B. S. Patil, Civil Engineering Contracts and Costing; Orient Blackswan Pvt. Ltd.
7. C.P.W.D. Manual.
8. Goa Schedule of Rates.

List of Experiments:

(At least 8 experiments should be conducted from the list of experiments)

1. Detailed estimate including plumbing with abstract for a single storied building having minimum three rooms with sloping and flat rcc roof and calculation of percentage cost for foundation, superstructure, roofing, woodwork, flooring, plumbing and finishing. Calculation of common raw material quantities used.

2. Preparation of road estimates with abstract for a new bituminous road surface involving all items of work to a length of one km including calculation of earth work and turfing/pitching.

3. Analysis of rates for **any six** of the common Civil Engg. Items:

i. Earth work excavation
ii. Plain cement concrete
iii. Laterite stone masonry in cement mortar
iv. Brick work in cement mortar
v. RCC work including steel but excluding farm work
vi. Wooden doors/windows (frames and shutters) including fixtures
vii. Flooring with pre caste terrace/mosaic tiles
viii. Internal and external plastering in cement mortar
ix. Mangalore tile roofing over wooden battens
x. Conventional water proofing and chemical water proofing
xi. Form work for columns, flats/sloping slabs and beams.

CE 7.4.1 ENVIRONMENTAL POLLUTION AND CONTROL

Subject Code	Nomenclature of the Subject	Scheme of Instruction Hrs/Week			Scheme of Instruction						
		L	T	P	Th. Duration (Hrs)	Marks					
						TH	S	TW	P	O	Total
CE 7.4.1	Environmental Pollution and Control	3	--	2	3	100	25	--	--	25	**150**

Course Objectives:

1. To know the pollution level of past, present and future.
2. To know the causes and effects of pollution on our surroundings.
3. To estimate the pollution and use proper control measures.

Course Outcomes:

The student after undergoing this course will be able to:

1. Understand the level and type of pollution present at a particular location.
2. Read and understand the Environmental conditions at a given location.
3. Estimate the pollution from the given source.
4. Suggest a particular line of treatment or control measures to prevent pollution.

UNIT - 1 (12 Hours)

Introduction: Definition. Air pollution past, Present and Future. Episodes and Global implications, Units of measurement, Sources of pollution and its classification. Effects of oxides of nitrogen, Sulphur dioxide, Carbon monoxide, SPM, Photochemical Smog etc. on Metals, Materials, Human health and Injury to vegetation.

UNIT - 2 (12 Hours)

Meteorology: Composition and Structure of the atmosphere, Wind circulation, Windrose diagram, Solar radiation, Adiabatic lapse rate, Environmental lapse rate, Atmospheric stability condition, Maximum mixing depth, Temperature inversion, Plume behavior, Heat island effects. Laboratory analytical methods of particulate concentration.

UNIT - 3 (12 Hours)

Pollutant Dispersion in the Atmosphere: Gaussian dispersion model, Plume rise, Stack design maximum ground level pollutant concentration, Concentration along line.

Calculation of effective stack height. Air quality standards, Criteria and Indices Ringelmann's charts. Global phenomenon like greenhouse effect, Ozone depletion, Acid rains.

UNIT - 4 (12 Hours)

Air Pollution Control Equipment's: Principles, Design, Operation and Maintenance of following devices – Gravitational setting chamber, Cyclone separator, Wet collector, Fabric filter, Electrostatic precipitator etc. Air pollution acts. Constitution and Functions of State and Central Pollution Control Board (SPCB and CPCB).

Recommended Readings:

1. Rao and Rao; Air Pollution; Tata McGraw-Hill Education.
2. Muralikrishna; Air Pollution; Laxmi Publication.
3. Perkins; Air Pollution; Mcgraw-Hill Book Company.
4. Peavy; Environmental Engineering; McGraw-Hill.
5. Crawford and Martin; Air Pollution Control Theory; McGraw-Hill Inc.

List of Experiments:

1. Determination of concentration of suspended particulate matter using High Volume Sampler.
2. Determination of pollution check of one petrol and one diesel vehicle.
3. Four assignments one on each unit.
4. Power point presentation on any one topic from the syllabus.

CE 7.4.2 FINITE ELEMENT METHOD

Subject Code	Nomenclature of the Subject	Scheme of Instruction Hrs/Week			Scheme of Instruction						
		L	T	P	Th. Duration (Hrs)	Marks					
						TH	S	TW	P	O	Total
CE 7.4.2	Finite Element Method	3	--	2	3	100	25	--	--	25	**150**

Course Objectives:

1. To equip the students with fundamentals of Finite Element Analysis.
2. To enable the students to formulate the design problems using FEA.
3. To understand Finite Element Techniques and its applications to real life problems.

Course Outcomes:

The student after undergoing this course will be able to:

1. Understand the basics of the Finite Element Technique, a numerical tool for the solution of different classes of problems in Engineering.
2. Understand the mathematical and physical principles underlying the FEA.
3. Demonstrate the ability to invoke appropriate assumptions, select proper elements and develop FEA models that adequately and efficiently represent physical systems.
4. Solve engineering problems using commercial softwares.

UNIT - 1 (12 hours)

Introduction to Finite Element method (FEM): General description of the method, Steps involved, Advantages, Range of applications. Basic Equations from linear theory of elasticity; Equilibrium equations, Compatibility equations, Strain displacement equations. Generalized Hooke's law; Constitutive laws for plane stress and Plane strain problems, Potential energy approach, Rayleigh-Ritz method, Galerkin's method. Matrix algebra and Solution of simultaneous using equations Gauss elimination, Crouts reduction and Cholesky's decomposition methods.

UNIT - 2 (12 hours)

Types of Elements, Discrete Systems: Analysis of one dimensional stress deformation problems; Generation of matrix displacement equations for spring element, 1-D bar element using direct and energy approach. Assembly of global stiffness matrix and Load vector, Treatment of boundary conditions and Solutions.

Co-ordinate System: Global, Local and Natural co-ordinate. Convergence requirement on displacement field. Shape functions for linear, Quadratic and Cubic 1-D element.

Analysis of Plane Trusses: Introduction, Plane trusses, Formulation of problem, Generation of element stiffness matrix, Assembly of global stiffness matrix and Load vector, Boundary conditions and Solution. Band width of a matrix.

UNIT - 3 (12 hours)

Shape functions for Constant Strain Triangle (CST), Linear Strain Triangle (LST) and 4-noded rectangular element. 2-D stress deformation, Finite element formulation, Derivation of element equation, Problem solution for two dimensional stress deformation problems using CST.

Introduction to Isoparametric element and its formulation; Jacobian matrix. Numerical integration; Guass Legendre quadrature technique.

UNIT - 4 (12 hours)

Stiffness matrix for a beam element. Hermite shape function. Applications to determinate and Indeterminate beams; Finite element formulation, Load vector, Boundary conditions, Shear force and Bending moment, Problem solution.

Dynamic Considerations in FEM: Introduction, Formulation of element mass matrix; for bar and beam element, Evaluation of Eigenvalues and Eigenvectors.

Recommended Readings:

1. J. N. Reddy; An Introduction to the Finite Element Method; McGraw-Hill.
2. T. R. Chandraputla, A. D. Belegundu, Introduction to Finite Elements in Engineering; Prentice Hall.
3. K. J. Bathe; Finite Element Procedure; Prentice-Hall of India.
4. C. S. Krishnamoorthy; Finite Element Analysis-Theory and Programming; Tata McGraw-Hill.

5. Desai and Abel; Introduction to the Finite Element Method; CBS Publishers.
6. Singiresu and Rao; The Finite Element Method in Engineering; Butterworth-Heinemann.
7. Saeed Moaveni; Finite Element Analysis - Theory and Application with ANSYS; Pearson Education limited.
8. Kattan, Peter; MATLAB Guide to Finite Elements; Springer.

List of Experiments:

1. Solution of Simultaneous equations using MATLAB
2. Solution of a truss using FEM and comparing the results with FEM software.
3. Solution of a simple 1-D problem such as Spring assemblage/beam in FEM and comparing with FEM software.
4. Solution of a simple 2-D problem in FEM and comparing with FEM software.
5. Generation of code to solve simple 1-D problem.
6. At least 3 assignments should be submitted from the syllabus.

CE 7.4.3 OCCUPATIONAL SAFETY AND HEALTH ACTS

Subject Code	Nomenclature of the Subject	Scheme of Instruction Hrs/Week			Scheme of Instruction						
		L	T	P	Th. Duration (Hrs)	Marks					
						TH	S	TW	P	O	Total
CE 7.4.3	Occupational Safety and Health Acts	3	--	2	3	100	25	--	--	25	**150**

Course Objectives:

1. To anticipate, recognize, evaluate, and develop control strategies for hazardous conditions and work practices.
2. To demonstrate an understanding of the fundamental aspects of safety, industrial hygiene, environmental science, fire science, hazardous materials, emergency management, ergonomics and/or human factors.
3. To apply adult learning theory to safety training methodology.
4. To identify and apply applicable standards, regulations, and codes.

Course Outcomes:

The student after undergoing this course will be able to:

1. Understand the importance of maintaining a safe workplace and understand that safety standards must be maintained in compliance with regulatory requirements and within engineering limits.
2. Demonstrate an understanding of workplace injury prevention, risk management, and incident investigations.
3. Demonstrate knowledge of safety recordkeeping and management, and the role of the safety manager.
4. Understand the acute and chronic health effects of exposures to chemical, physical and biological agents in the workplace. Graduates will demonstrate knowledge of different types of exposure and biological effects, exposure guidelines and basic workplace monitoring.

UNIT – 1 (12 hours)

Occupational Health: Concept of occupational health, Occupational and Work related diseases, History of occupational health, Characteristics of occupational diseases.

Occupational Health Hazards: Adverse health effects of noise, Vibration, Cold, Heat stress, Improper illumination, Thermal radiation.

Permissible Threshold Exposure Limits: Short term and Long term effects of exposures; Preventive and Control measures.

UNIT – 2 (12 hours)

Accident and Incident Investigation: Definition; Incident, Accident, Injury, Unsafe acts, Unsafe conditions, Hazards, Error, Oversight, Mistakes etc.

Accident and Incident Analysis: Standard classification of factors associated with accident. Accident reporting: Report forms, Writing reports, Essential elements.

Factories Act, Workmen's Compensation Act and Rules, ESI Act and Rules, Labour Act (Abolition And Regulation), Right to Know.

UNIT – 3 (12 hours)

Risk Assessment and Hazard Identification: Preliminary hazard analysis, What if analysis, Failure mode effect analysis, Hazard and Operability (HAZOP) studies, Hazard analysis techniques; Fault tree analysis, Event tree analysis, On-site and Off-site emergency preparedness.

Meaning and Scope of Safety in Construction: Basic parameters governing the safety in construction e.g.: Scaffolding, shuttering/form work, Working at Heights, Safe access, Good housekeeping, Safety in the use of construction machinery Safety with regard to storage, Stocking and Handling materials of construction. Safety in demolition operations; Safety precautions to be taken for and during demolition.

UNIT – 4 (12 hours)

Employee Participation in Safety: Purpose, Areas of participation, Methods, Role of trade union in Safety Health and Environment Protection.

Personal Protective Equipment: Need for personal protection equipment, selection, Applicable standards, Care and Maintenance of respiratory and Non-respiratory personal protective equipment. Non-respiratory personal protective devices: Head protection, Ear protection, Face and Eye protection. Hand protection, Foot protection, Body protection, Respiratory personal protective devices.

Recommended Readings:

1. D. L. Goetsch; Occupational Safety and Health for Technologists; Engineers and Managers, Prentice Hall.
2. H. W. Heinrich; Industrial Accident Prevention; McGraw Hill Publication, New York.
3. D. A. Colling; Industrial Safety Management and Technology; Prentice Hall, New Jersey.
4. R. K. Mishara; Construction Safety; AITBS Publishers, India.
5. D. E. Della and Giustina; Safety and Environmental Management; Van Nostrand Reinhold International Thomson Publishing Inc.
6. CPHEEO; Manual on Sewerage and Sewage Treatment; Ministry of Urban Development, GOI, New Delhi.
7. Industrial Safety and Pollution Control Handbook; National Safety Council and Associate (Data) Publishers Pvt. Ltd.
8. Woodson; Human Factors Design Engineering; Tata McGraw Hill.

List of Experiments:

1. To prepare a detailed report on types of works involved in a Construction industry and the various types of risks involved and suggest corrective measures.
2. A detailed Project report on Industrial Safety measures adopted for the protection of workers and employees involved in any one type of industry.
3. To create a scenario of an incident and prepare an accident report, carry out root cause analysis and propose corrective measures.
4. Map the types of PPEs required in any one type of activity/job by the workers.

CE 7.4.4 ADVANCES IN CONCRETE TECHNOLOGY

Subject Code	Nomenclature of the Subject	Scheme of Instruction Hrs/Week			Scheme of Instruction						
						Marks					
		L	T	P	Th. Duration (Hrs)	TH	S	TW	P	O	Total
CE 7.4.4	Advances in Concrete Technology	3	--	2	3	100	25	--	--	25	**150**

Course Objectives:

1. To impart knowledge of concrete making materials and their interrelationship
2. To understand concrete production.
3. To understand the effect of chemical and mineral admixtures.
4. To understand durability and stability of concrete.
5. To impart knowledge about special concretes viz. light weight concrete, fiber reinforced concrete.

Course Outcomes:

The student after undergoing this course will be able to:

1. Apply different concrete making materials.
2. Understand concrete properties and production process.
3. Apply concrete as a modern material of construction.
4. Select appropriately different concrete ingredients.

UNIT - 1 (12 Hours)

Review of Properties of Materials: Cement physical and chemical properties, Classification and properties of aggregates, soundness of aggregates, alkali aggregate reaction.

Rheology of Concrete: Importance of Bogue's compounds, Structure of a hydrated cement paste, Volume of hydrated product, Porosity of paste and concrete, Transition Zone, Elastic Modulus, Factors affecting strength and Elasticity of concrete.

Chemical and Mineral Admixtures: Mechanism of chemical admixture, Plasticizers and Super Plasticizers and their effect on concrete property in fresh and hardened state, Marsh cone test for optimum dosage of super plasticizer, Retarder, Accelerator, Air-entraining admixtures, New generation superplasticizer. Fly ash, Silica fume, GCBS, and their effect on concrete property in fresh state and hardened state.

UNIT - 2 (12 Hours)

Special Concrete: High strength, Lightweight, heavy weight, vacuum processed concrete, Mass concrete, high performance concrete, Pumpable concrete, Self-Compacting concrete, Air entrained concrete, Ferro cement, Fiber reinforced concrete, Polymer impregnated concrete, Jet concrete. Recycling and Re-use of industrial waste material. Deterioration and Repair technology of concrete, Distress and Type of repairs, Crack sealing techniques.

UNIT - 3 (12 Hours)

Test on Hardened Concrete: Effect of end condition of specimen, Capping, H/D ratio, rate of loading, Moisture condition. Compression, Tension and Flexure, Shear and Impact tests on concrete.

RMC Concrete: Manufacture, Transporting, Placing, Precautions, Methods of concreting-Pumping, under water concreting, Shotcrete, Guniting.

High Volume Fly Ash Concrete: Concept, Properties, Typical mix design.

Self Compacting Concrete: Concept, Materials, Tests, Properties, Application and Typical mix Design.

UNIT - 4 (12 Hours)

Durability of Concrete: Introduction, Permeability of concrete, Chemical attack, Acid attack, Efflorescence, Corrosion in concrete, Fire resistance, Frost damage. Thermal conductivity, Thermal diffusivity, Specific heat. Alkali Aggregate Reaction, Delayed ettringite formation. IS 456-2000 requirement for durability.

Non Destructive Test: Concepts, Rebound hammer, Pulse velocity methods.

Recommended Readings:

1. M. S. Shetty; Concrete Technology; S. Chand co.
2. A. M. Neville; Concrete Technology; Prentic Hill.
3. M. L. Gambhir; Concrete Technology; McGraw Hill Education India Pvt. Limited.
4. S. S. Bhavikatti; Concrete Technology; I. K. Publishing House Pvt. Ltd., New Delhi.
5. John Newman and Ban SengChoo; Advanced Concrete Technology; Elsevier.
6. P.K. Mehta, P. J. M. Monteiro; Concrete; Prentice Hall, New Jersey (Special Student Edition by Indian Concrete Institute Chennai).

7. N. Krishna Raju; Concrete Mix Design; Sehgal Publishers.
8. M. L. Gambhir; Concrete Manual; Dhanpat Rai and Sons, New Delhi.
9. ACI Code for Mix Design.
10. IS 10262.

List of Experiments:

(At least 8 experiments should be conducted from the list of experiments)

1. Determination of Soundness test on aggregate
2. Marsh cone test for determine optimum dosage of admixtures.
3. Compression, tensile, flexure, shear and impact test on concrete.
4. Determination of Modulus of elasticity of concrete and strain measurement by longitudinal compressometer.
5. Tests on fresh self-compacting concrete (U-box, L-box, Fill-box, J-ring, slump flow, V-funnel).
6. Determination of compressive strength of self-compacting concrete by conducting mix design.
7. Determination of Compressive strength of concrete by non-destructive test – Rebound Hammer.
8. Determination of Compressive strength of concrete by non-destructive test – pulse velocity meter.

CE 7.4.5 REINFORCED EARTH STRUCTURES

Subject Code	Nomenclature of the Subject	Scheme of Instruction Hrs/Week			Scheme of Instruction						
		L	T	P	Th. Duration (Hrs)	Marks					
						TH	S	TW	P	O	Total
CE 7.4.5	Reinforced Earth Structures	3	--	2	3	100	25	--	--	25	**150**

Course Objective:

1. To introduce different types of geosynthetics.
2. To impart knowledge about manufacturing techniques, testing methods and applications of geosynthetics in different types of Civil Engineering projects.
3. To understand design and construction methods of geosynthetic reinforced structures.

Course Outcomes:

The student after undergoing this course will be able to:

1. Understand the concept of reinforced soil, its advantages and uses.
2. Understand the types of Geosynthetics used as reinforcements, methods of testing the Geosynthetics.
3. Analyze and design reinforced soil structures using geosynthetics.
4. Understand, analyze and design reinforced landfills.

UNIT - 1 (12 Hours)

Introduction: Historical background of reinforced earth, Principles of reinforced soil through Mohr circle analysis, Materials and Failure modes.

Different Types of Geosynthetics: Types of geosynthetics, Geotextiles, Geogrids, Geonets, Geocells, Geo-composites and their manufacturing methods. Functions of geosynthetics, Properties; Physical, Chemical, Mechanical, Hydraulic.

Testing Methods for Geosynthetics: Techniques for testing of different index properties, Strength properties, Apparent opening size, In-plane and Cross-plane permeability tests, Assessment of construction induced damage, Extrapolation of long term strength properties from short term tests. Manufacturing of geosynthetics, Functions, Properties.

UNIT - 2 (12 Hours)

Reinforced Soil Retaining Walls: Different types of walls; Wrap-around walls, Full-height panel walls, Discrete-facing panel walls, and Modular block walls. Design methods as per BS-8006 and FHWA methods Construction methods for reinforced soil retaining walls, Design of reinforced soil walls and Design of Gabion wall.

Reinforced Soil Slopes: Basal reinforcement for construction on soft clay soils, Construction of steep slopes with reinforcement layers on soils, Different slope stability analysis methods; Planar wedge method, Bi-linear wedge method, Circular slip methods. Erosion control on slopes using geosynthetics. Soil nailing techniques, Geosynthetic reinforced soil embankments.

UNIT - 3 (12 Hours)

Applications in Foundations: Binquet and Lee's approach for analysis of foundations with reinforcement layers. Improvement of bearing capacity using reinforcements

Drainage and Filtration Applications of Geosynthetics: Different filtration requirements, Filtration in different types of soils and Criteria for selection of geotextiles. Estimation of flow of water in retaining walls, Pavements, Drains, Designing and Selection of geosynthetics for drainage and Filtration.

Pavement Application (Roads and Railways): Geosynthetics for separation and Reinforcement in flexible pavements, Design by Giroud-Noiray approach, Reflection cracking and Control using geosynthetics. Use of geosynthetics for construction of heavy container yards and Railway lines.

UNIT - 4 (12 Hours)

Construction of Landfills using Geosynthetics: Different components of modern landfills, Collection techniques for leachate, Application of different geosynthetics like geonets, Geotextiles for drainage in landfills, Use of geomembranes and Geosynthetic Clay Liner (GCL) as barriers, EPA guidelines

Recommended Readings:

1. R. M. Koerner; Designing with Geosynthetics; Prentice Hall, New Jersey, USA, 4th edition.

2. G. L. Sivakumar Babu; An Introduction to Soil Reinforcement and Geosynthetics; Universities Press.
3. I. K. Swami Saran; Reinforced Soil and Its Engineering Applications; International Pvt Ltd.
4. R. A. Jewell; Soil Reinforcement with Geotextiles; Special Publication No. 123, CIRIA, Thomas Telford. London, UK.
5. G.V. Rao, P. K. Banerjee, J.T. Shahu, G.V. Ramana; Geosynthetics; New Horizons, Eds. Asian Books Private Ltd., New Delhi.
6. Colin J. F. P. Jones; Earth Reinforcement and Soil Structures; Elsevier.
7. Federal Highway Administration (FHWA) Guidelines.
8. ASTM D 4595, ASTM D 6638, ASTM D 4354, ASTM D 6637, ASTM D 6706,
9. IRC SP 102
10. IS Codes: IS 8006: Part I.

List of Experiments:

1. Application of numerical methods and softwares for solving assignments based on the above syllabus.
2. Mini group projects based on design can be given to the students.
3. At least one field visit to any project using reinforced earth.

CE 7.5.1 APPLIED ENGINEERING GEOLOGY

Subject Code	Nomenclature of the Subject	Scheme of Instruction Hrs/Week			Scheme of Instruction						
		L	T	P	Th. Duration (Hrs)	Marks					
						TH	S	TW	P	O	Total
CE 7.5.1	Applied Engineering Geology	3	--	2	3	100	25	--	--	25	**150**

Course Objectives:

1. To understand the different types of geological structures and weathering effect on rocks.
2. To understand sea wave processes to adopt protective measures to stabilize them.
3. To select proper method and equipment for excavation in different geological material.
4. To stabilise slopes in rocks and soils.

Course Outcomes:

The student after undergoing this course will be able to:

1. Evaluate rock-mass quality and perform a kinematic analysis.
2. Calculate the bulk properties of rocks such as density, void ratio, water contents, and unit weights.
3. To protect ports and harbours as well various coastal structures.
4. To understand the surface and subsurface structures by means of geophysical surveys.

UNIT – 1 (12 Hours)

Study of Rock Structures: Origin of joints, Cleavage, Schistosity and Lineation and their classification, Significance of rock cleavage.

Coastal Engineering: Waves and tides; Wave motion, Force and Height of waves, Beach zones, Wave refraction, Tides, and Changes in sea level. Coastal erosion and deposition; Coastal erosion, Beaches, Long shoe drift, Offshore bars. Shoreline investigation and Data acquisition: Recording devices, Topographic surveys, Measurements of water levels, Movement of sediments.

Methods of Shoreline Protection: Sea walls, Wave breakers, Cohesive and Embankments, Revetments, Bulkheads, Methods of stabilisation of longshore drift; Groins, Beach replenishment.

UNIT – 2 (12 Hours)

Excavation in Rocks and Soils: Excavation in Igneous, Metamorphic and Sedimentary rocks, Cohesive and Non-cohesive soils.

Methods of Open (Surface) Excavation: Drilling and Blasting, Ripping, Digging, Factors influencing rock slope stability, Analysis of stability of rock slopes and Soil slopes (any one method each), Methods of slope control.

Excavation of Tunnels (Sub Surface Excavation): Machine tunnelling in soft ground, Machine tunnelling in hard rocks, Drilling and Blasting, Control of over breakage.

Rock Weathering: Rate of weathering, Engineering classification of weathering (any three), Assessment of the degree of weathering

UNIT – 3 (12 Hours)

Engineering Seismology: Introduction, Intensity and Magnitude of Earthquakes, Ground condition and Seismicity. Methods of seismic investigation, Dynamic analysis, Seismic zoning, Structural damage and its prevention. Induced seismicity; Earthquakes and Dams.

Exploration Geophysics: Introduction, Electrical method; Principles, Instrumentation, Wenner and Schlumberger methods. Seismic methods; Principles, Instrumentation, Gravity and Magnetic methods: Introduction, Principles.

UNIT – 4 (12 Hours)

Rock Mechanics: Introduction, Application, Definition and Introduction to engineering and general properties; Porosity, Density, Void index, Permeability, Water absorption, Slake durability index. Strength properties, Jointing in rocks classification systems in rock engineering.

Mining Geology: Outlines of surface methods of mining, Underground mining, Stoping methods, Principles of sampling and sampling methods, Core drilling (wet and dry), Type of core bits, Casing and their applications, Mine ventilation, Mine gases and Mine diseases. Slope stability in open cast mines, Dewatering techniques in open cast and underground mines.

Recommended Readings:

1. N. Chenna Keavalu; Text book Engineering Geology; McMillan India.
2. F. G. Bell; Engineering Geology and Geotechnics; Newnwss Butterworths, London.
3. M. P. Billings; Structural Geology; Prentice Hall of India Pvt. Ltd, New Delhi.
4. B. P. Verma; Rock Mechanics for Engineers; Khanna Publishers.
5. R. B. Gupte; A Textbook of Engineering Geology; Pune Vidyarthi Griha Prakashan.
6. Kearey and Brooks; An introduction to Exploration Geophysics; Blackwell scientific publication, 1984.
7. Sharma P. V.; Geophysical methods in Geology; Elsevier, 1986.
8. Ramachandra Rao, M. B.; Outline of Geophysical Prospecting; Wesley press, 1975.
9. R. N. P. Arogyaswamy; Course in Mining Geology; Oxford and IBH Publishers.

List of Experiments:

(At least 8 experiments should be conducted from the list of experiments)

1. Toposheet map reading.
2. Use of Brunton compass and clinometer compass.
3. Water quality problems.
4. Interpretation of resistivity and seismic refraction data.
5. Identification and study of natural construction materials, building stones and decoration.
6. Completion of outcrops and preparation of geological sections.
7. Problems on structural geology (thickness of strata, strike and dip).
8. Problems on structural geology (borehole data).
9. Basics of groundwater flow nets.

CE 7.5.2 DISASTER MANAGEMENT

Subject Code	Nomenclature of the Subject	Scheme of Instruction Hrs/Week			Scheme of Instruction						
		L	T	P	Th. Duration (Hrs)	Marks					
						TH	S	TW	P	O	Total
CE 7.5.2	Disaster Management	3	--	2	3	100	25	--	--	25	**150**

Course Objectives:

1. To describe the basic types of hazards and their potential consequences
2. To understand the strengths and weaknesses of disaster management approaches
3. Understand how to react effectively to natural, man-made, and technological threats.

Course Outcomes:

The student after undergoing this course will be able to:

1. Develop an understanding of the key concepts, definitions , key perspectives of All Hazards, Emergency Management
2. Have a basic understanding for the history of Emergency Management
3. Develop a basic understanding of Prevention, Mitigation, Preparedness, Response and Recovery.

UNIT - 1 (12 Hours)

Introduction to Disasters, Classification, Causes, Impacts: Concept and Definitions of different terms of disaster. Approaches to understand disaster phenomena (natural science, applied, science, progressive and holistic approaches). Parameters of disaster risk levels of disaster as per national guideline.

Classification of Hazards (Natural and Manmade): General characteristics and Problem areas of different natural and Man-made hazards (e.g. Flood, Erosion, Earthquake, Landslide, Lightning, Tropical Cyclone, Drought, Civil Unrest etc.).

Disaster Trends (Global, National and Regional): Response time, Frequency, Forewarning, Exposure time of different hazards. Common approaches to study natural and manmade hazards; Vulnerability and Disasters. Differential impacts- in terms of Caste, Class, Gender, Age, Location, Disability.

UNIT - 2 (12 Hours)

Disaster Risk Mitigation: Disaster risk assessment (Hazard-Vulnerability-Capacity analysis), Hazard mapping and Forecasting. Principles and Aspects of Disaster prevention, Disaster mitigation. Preparedness for damage mitigation and coping with disasters. Capacity building for disaster/damage mitigation (structural and non-structural measures). Contingency planning for damage mitigation of different hazards. Relevance of indigenous knowledge, appropriate technology and local resources in disaster risk mitigation. Community based disaster risk reduction mechanism. Counter disaster resources and their roles. Selected models for understanding the causes of disaster and disaster risk mitigation.

UNIT - 3 (12 Hours)

Environment and Disasters: Environment, Ecosystem and Disasters. Climate change issues and Concerns. Industrial hazards and Safety measures. Post disaster impact on environment. Impact of developmental projects on disaster risk. Aspects of environmental management for disaster risk reduction. Environmental Impact Assessment (EIA).

UNIT - 4 (12 Hours)

Planning for Disaster Management: Community; Hazard profile in India. Different phases of Disaster Management (DM cycle). Relief mechanism (needs assessment, relief administration and distribution, management of relief centres, external support etc.). Compensation and Insurance. Planning strategies (state and district DM planning); planning needs. Disaster Management Act (2005); Disaster Management Policy (2009); organizational framework for disaster management in India.

Recommended Readings:

1. Alexander, D.; Natural Disasters; ULC press Ltd, London.
2. W. N. Carter; Disaster Management: A Disaster Management Handbook; Asian Development Bank, Bangkok, 1991.
3. Donald Hyndman and David Hyndman; Natural Hazards and Disasters; Cengage Learning.
4. Savinder Singh; Environmental Geography; Prayag Pustak Bhawann.
5. B. I. Kates and G. F. White; The Environment as Hazards; Oxford, New York.
6. R. B. Singh (Ed); Disaster Management; Rawat Publication, New Delhi.

7. R. B. Singh; Space Technology for Disaster Mitigation in India (INCED); University of Tokyo.
8. Satender; Disaster Management in Hills; Concept Publishing Co., New Delhi.

List of Experiments:

1. Vulnerability assessment of selected area in locality/town/city.
2. Visit to any public building for studying their disaster management plan.
3. Report on national disaster management guidelines for floods.
4. Report on national disaster management guidelines for earthquakes.
5. Report on national disaster management guidelines for cyclones.
6. Report on national disaster management guidelines for tsunamis.
7. Report on national disaster management guidelines for droughts.
8. Study of hazard maps of different areas.
9. Environmental impact assessment of development projects.

CE 7.5.3 TRAFFIC ENGINEERING

Subject Code	Nomenclature of the Subject	Scheme of Instruction Hrs/Week			Scheme of Instruction						
					Th. Duration (Hrs)	Marks					
		L	T	P		TH	S	TW	P	O	Total
CE 7.5.3	Traffic Engineering	3	--	2	3	100	25	--	--	25	**150**

Course Objectives:

1. To impart knowledge of various traffic characteristics, methods of traffic survey and studies.
2. To study basic geometric elements, traffic signs and signals and street lighting.

Course Outcomes:

The student after undergoing this course will be able to:

1. Understand methods of conducting traffic survey, types of intersections, methods of light distribution, parking studies and analysis.
2. Understand the design principles of Traffic Engineering.

UNIT - 1 (12 Hours)

Traffic Characteristics: Conventional and Modern Methods of traffic survey and Studies; Physical, Physiological, Psychological, Environmental characteristics, Traffic stream Characteristics, Vehicle characteristics; Static and Dynamic.

Traffic Flow: Fundamentals of traffic flow; Flow characterization, Fundamental relation of traffic flow, Traffic segregation, Uninterrupted traffic flow, Stream characteristics, Macroscopic and Microscopic traffic flow models, Fundamentals of interrupted traffic flow, Shock waves, Traffic flow at signalized intersections, Traffic flow at unsignalized intersections, Data collection.

UNIT - 2 (12 Hours)

Traffic Geometrics: Channelization, islands, Rotary intersections, Types of intersections.

Design of Traffic Facilities: Intersections, Unsignalized intersections, Signalized intersections, Interchanges; Design of interchanges, Channelization design.

Traffic Regulation and Street Lighting: Traffic signs and Types, Regulatory, Mandatory, Warning signs, Route marker, Lane marking, Lane width standards as per IRC.

Traffic Signals: Types of traffic signal systems, Design of traffic signal, Approximate method, Webster method, IRC method. Street Lighting; Methods of light distribution, Design of street lighting system, Utilization and Maintenance factors, Types of light sources used for street lighting, Fundamental factors of night vision.

UNIT - 3 (12 Hours)

Parking Studies and Analysis: Types of parking facilities, Parking demand, On street parking, Off street Parking, Parking stalls, Vehicle Circulation, Design of parking facility.

Traffic Safety: Accident studies and Analysis; Causes of accidents; Enforcement and Education measures for the prevention of accidents.

UNIT - 4 (12 Hours)

Traffic Control and Regulation: Traffic Signals, Design of isolated traffic signal by Webster method, Warrants for signalisation, Signal co-ordination methods; Simultaneous, Alternate, Simple progression and Flexible progression systems.

Traffic and Environment: Detrimental effects of traffic on environment; Measures to curtail environmental degradation due to traffic.

Recommended Readings:

1. Partha Chakroborty and Animesh Das; Principles of Transportation Engineering; PHI, New Delhi.
2. L. R. Kadiyali; Traffic Engineering and Transportation Planning; Khanna Publishers.
3. Louis J. Pignataro; Traffic Engineering - Theory and Practice; Prentice Hall Publication.
4. C. Jotin Khistry; Transportation Engineering - An Introduction; Prentice Hall Publication.
5. S. K. Khanna, C. E. G Justo; Highway Engineering; Nem Chand and Bros.
6. S. K. Sharma; Principles, Practice and Design of Highway Engineering; S Chand and Company.
7. Fred Mannering and Walter Kilareski; Principles of Highways Engineering and Traffic Analysis; John Wiley and Sons Publication.

8. IRC Codes: IRC SP19, IRC 002, IRC003, IRC 011, IRC031 , IRC093 and IRC 092.

List of Experiments:

1. To determine the traffic volume count on a road system by means of
   i. Manual count
   ii. Automatic counters
2. To determine the parking statistics at a given location
3. To study the accident analysis in a given area
4. To study the traffic flow patterns at intersection
5. To design traffic islands for a congested area
6. Analyse data using traffic analysis software

CE 7.5.4 STRUCTURAL DYNAMICS

Subject Code	Nomenclature of the Subject	Scheme of Instruction Hrs/Week			Scheme of Instruction						
		L	T	P	Th. Duration (Hrs)	Marks					
						TH	S	TW	P	O	Total
CE 7.5.4	Structural Dynamics	3	--	2	3	100	25	--	--	25	**150**

Course Objectives:

1. To learn how to analyze the behavior of physical structures subjected to dynamic loadings.
2. To formulate equations of motion for dynamic problems.
3. To evaluate the response of dynamic problems.

Course Outcomes:

The student after undergoing this course will be able to:

1. Understand the principles of structural dynamics, time varying load and response.
2. Identify components of dynamic system and formulate equation of motion for a dynamic problem.
3. Find solutions of single degree and multi-degree of freedom system problems using analytical and numerical techniques.
4. Determine lateral loads due to earthquake.

UNIT - 1 (12 hours)

Introduction to Structural Dynamics: Dynamic problems in Civil Engineering, Static versus dynamic problems, Different types of dynamic loads, Concept of degrees of freedom, D'Álembert's principle, Principle of virtual displacements and Energy principles.

Single Degree Freedom System (SDOF): Mathematical models of single degree of freedom system, Derivation of equations of motion for free vibrations of SDOF systems, Damped free vibrations, Critical damping, Free vibration response for damped and undamped systems.

UNIT - 2 (12 hours)

Response of SDOF systems to harmonic loading including support motion, Reciprocating unbalance, Vibration isolation and Transmissibility, Load factor.

Single degree freedom system, Response to impulsive loading, Rectangular, Triangular pulses, Duhamel Integral. Response to general dynamic loading.

Numerical Solution for SDOF Systems: Wilson-Theta, Newmark-Beta, Constant linear acceleration. Time domain and Frequency domain analysis.

UNIT - 3 **(12 hours)**

Dynamics of Multi-degree freedom system, Mathematical models of multi-degree freedom system. Free vibration response, Fundamental frequencies and Mode shapes, Orthogonality of modes.

Response to dynamic loading, Formulations of equations of motion, Normal coordinates mode superposition method, Modal matrix, Numerical scheme of Wilson and Newmark.

UNIT - 4 **(12 hours)**

Structural response to earthquake, Wind and Ground motion characteristics, Response spectrum design earth quake, IS code provisions for multistorey frames.

Recommended Readings:

1. Anil. K Chopra; Dynamics of structures - Theory and Application to Earthquake Engineering; Pearson Education.
2. M. Mukhopadhya; Structural Dynamics: Vibrations and systems; Oxford IBH.
3. Mario Paz; Structural Dynamics; CBS publishers.
4. Ray W. Clough, Joseph Penzien; Dynamics of Structures; Computers and structures.
5. Franklin Y. Cheng, Marcel Dekker; Matrix Analysis of Structural Dynamics: Applications and Earthquake Engineering; CRS press.

List of Experiments:

1. Free vibration test on SDOF system OR equivalent analytical analysis
2. Free vibration test on MDOF system OR equivalent analytical analysis.
3. Dynamics of a multi storied building frame subjected to harmonic base motion OR equivalent analytical analysis

4. Dynamics of a one-storied building frame with planar asymmetry subjected to harmonic base motions. OR equivalent analytical analysis
5. Dynamics of a Multi- storied building frame subjected to periodic (non-harmonic) base motion OR equivalent analytical analysis
6. At least 4 assignments should be submitted based on the syllabus.

CE 7.5.5 STRUCTURAL DESIGN OF FOUNDATIONS

Subject Code	Nomenclature of the Subject	Scheme of Instruction Hrs/Week			Scheme of Instruction						
		L	T	P	Th. Duration (Hrs)	Marks					
						TH	S	TW	P	O	Total
CE 7.5.5	Structural Design of Foundations	3	--	2	3	100	25	--	--	25	**150**

Course Objectives:

1. To impart knowledge about the design principles of various foundation types.
2. To perform soil and structural design of various types of foundation types.

Course Outcomes:

The student after undergoing this course will be able to:

1. Select the appropriate type of foundation suitable for given soil conditions.
2. Select appropriate design properties for various types of foundations.
3. Design various types of foundations.

UNIT - 1 (12 Hours)

Introduction: Soil exploration, Analysis and Interpretation of soil exploration data, Estimation of soil parameters for foundation design. Methods for bearing capacity estimation, Total and Differential settlements of footing and raft, Codal provisions.

Shallow Foundations: Design of individual footings, Strip footing, Combined footing, rigid and Flexible mat, Buoyancy raft, Basement raft.

Machine Foundations: Basic definitions in vibration, Free and Forced vibrations, Determination of natural frequency, Types of machine foundations, General criteria for design of machine foundation, Vibration analysis of a machine foundation, Degrees of freedom of a block foundation, Vibration isolation and Control.

UNIT - 2 (12 Hours)

Pile Foundations: Estimation load carrying capacity of single and Pile group under various loading conditions. Pile load testing (static, dynamic methods anddata interpretation), Settlement of pile foundation, Code provisions, Design of single pile and Pile groups, and Pile caps.

Well Foundations: Types, Components, Construction methods, Design methods (Terzaghi, IS and IRC approaches), Check for stability, Base pressure, Side pressure and Deflection.

UNIT - 3 (12 Hours)

Retaining Walls: Types (Types of flexible and Rigid earth retention systems; Counter fort, Gravity, Diaphragm walls, Sheet pile walls, Soldier piles and Lagging). Support systems for flexible retaining walls (struts, anchoring), Construction methods, Stability calculations, Design of flexible and Rigid retaining walls, Design of cantilever and Anchored sheet pile walls.

UNIT - 4 (12 Hours)

Soil-Foundation Interaction: Idealized soil, Foundation and Interface behaviour. Elastic models of soil behavior; Elastic, Plastic and Time dependent behaviour of soil. Beams and Plates on elastic foundation; Numerical analysis of beams and Plates resting on elastic foundation.

Recommended Readings:

1. A. P. S. Selvadurai; Elastic Analysis of Soil-Foundation Interaction; Elsevier Scientific Publishing Company.
1. Braja M. Das; Principles of Foundation Engineering; PWS Publishing Company.
2. Joseph Bowles; Foundation Analysis and Design; McGraw-Hill Book Company.
3. V. N. S. Murthy; Advanced Foundation Engineering; CBS Publishers and Distributors.
4. Nainan Kurian; Design of Foundation systems; Narosa Publishing House, New Delhi.
5. P. C. Varghese; Advanced Foundation Design; Prentice Hall.
6. H. G. Poulos and E. H. Davis; Pile foundation Analysis and Design; John-Wiley Sons, NY.
7. IS Codes: IS 1904, IS 2911: Part I: Section 1 to 4, IS 2911: Part III, IS 2950: Part I and IS 2974: Part I to V.

List of Experiments:

The following assignments can be undertaken during the practical session:

1. Case study of Caisson foundation
2. Case study of pile load test
3. Design of foundation using soil structure interaction concepts
4. Design of piles for bridge structure
5. Design of pile group and pile cap
6. Design of pile foundation using software
7. Designing and drawing of counterfort retaining wall (manually or with software)
8. Technical review and critique of a research article/paper on any one of the topics – (1) Drilled Shaft (2) Caisson - Construction, Analysis, Design, Problems, Case Study A detailed review and critique of a research article/paper in writing (5-10 pages) is expected from the students.

CE 7.6 PROJECT

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Instruction						
		L	T	P	Th. Duration (Hrs)	Marks					
						TH	S	TW	P	O	Total
CE 7.6	Project	--	--	4	--	--	--	--	--	25	**25**

Guidelines for Project Work:

1. Project can be undertaken in-house or in an industry or in a research /service organization.
2. Project batch will consist of maximum six students.
3. The Project Title / Synopsis should be prepared in the beginning of the term and approved by a designated departmental committee.
4. The topic of the project may be in the area related to civil engineering. It may involve investigation/ analytical study / experimental work / fabrication / Statistical study / simulation etc. The project should be preferably being taken in the latest trends in Engineering and Technology.

Project Report:

The Project (Interim) report shall consist of the following:

a. Problem identification.
b. Statement of problem.
c. Formulation of the objective and Scope of the study.
d. Literature review.
e. Methodology to be adopted.

Review:

Monthly review to assess the progress of the project work will be conducted by the Guide. Students shall submit project reports to the department and make a presentation before the departmental committee at the end of Semester.

CE 8.1 IRRIGATION AND WATER RESOURCES ENGINEERING

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Instruction						
					Th. Duration (Hrs)	Marks					
		L	T	P		TH	S	TW	P	O	Total
CE 8.1	Irrigation and Water Resources Engineering	4	1	--	3	100	25	--	--	--	**125**

Course Objectives:

1. To gain basic knowledge of Hydrology.
2. To understand the design parameters of reservoir and dams, operation and sedimentation, failure and control.
3. To understand various irrigation techniques and requirements of the crops.
4. To get an insight of Distribution systems for canal irrigation, design of unlined and lined irrigation canals design sediment problems associated with canal.

Course Outcomes:

The student after undergoing this course will be able to:

1. Know Various Stream flow measurements technique, hydrologic cycle.
2. Know the basic requirements of irrigation and various irrigation techniques, requirements of the crops.
3. Understand distribution systems for irrigation and the basics of design of reservoirs, dams, unlined and lined irrigation canals.
4. Understand effective usage of water resources.

UNIT - 1 (16 Hours)

Introduction: Necessity, Planning, C-B ratio, Inter and Intra basin transfer, Different methods of irrigation, Irrigation from ground water deep and Shallow wells, Tube wells. Water Requirement of Crops; Duty and Delta, Base period of crops, Factors affecting duty, Methods of improving duty, Crop seasons in India

Basic Hydrology: Hydrological cycle, Precipitation, Analysis of data, Supplementing missing data, Consistency of record, Hyetograph, Mass curve analysis, Measurements of rainfall, evaporation and Evapo-transpiration, Infiltration and Soil moisture, Stream flow measurement; Runoff, Factors affecting runoff, Catchment classification, Flood estimation, Hydrograph, Unit hydrograph Synthetic unit hydrograph, S- curve, Unit hydrograph of

varied durations, Instantaneous unit hydrograph, Conceptual models. Computation of peak flow, Flood Routing

UNIT - 2 (16 Hours)

Storage Reservoirs: Physical characteristics of reservoirs, Reservoir capacity for a given yield, Mass curve, Reservoir reliability, Sedimentation control, Reservoir leakage, Ideal site for reservoir.

Dams: Types of Dams, Suitability of a type of dam. Forces acting on dams, Failure of dams and criteria for structural stability, Principal and Shear stress, Stability analysis, Elementary profiles, Design criteria, Causes of failures, Control of Seepage, Stability of slopes, Design considerations, for Gravity, Earth dams. High and Low gravity dams, Openings in dams, Functions and Effects of opening, Joints, Keys and Water stops in gravity dams, Foundation treatment for various dams.

Spillways and Energy Dissipaters: Introduction, Essential requirements of a spillway, Spillway capacity, Components, Types of spillways, Design of Ogee spillway, Energy dissipation below spillways.

UNIT - 3 (16 Hours)

Diversion Headworks: Introduction, Types of diversion works, Location and Components, Weir and Barrage, Effect of construction of weir on the river regime, Causes of failures of Weirs on permeable foundations, their remedies, Exit gradient, Principles of weir design on permeable formations, Bligh's creep theory and Khosla's theory.

Distribution Systems: Classification of canals, Design of irrigation canals by Kennedy's and Lacey's theories, Canal FSL, Losses of canal water, Silting and Scouring of canals, Method of design of unlined section of irrigation canal, Lined canals, IS standard for Design of canal lining, Satellite automated canals, Problem of water logging and Environmental concerns

Regulation Works: Introduction, Definition of falls, Necessity and Location of falls, Comparative study of the main types of falls, Cross regulator and Distributary regulator. Hydraulic Gates Control equipment's for out-lets, Spillway gates, Types, Design criteria for radial gates, Air vents, Canal escapes.

Cross Drainage Works: Introduction, Types, Suitability, Design of various types of C-D Works, Aqueduct, Syphon aqueduct, Super Passage, Syphon, Level crossing, Inlets and Outlets, Site selection.

UNIT - 4 (16 Hours)

Hydropower Engineering: Introduction, Components of hydropower, Classification of hydropower plants, Run-of-river plants, Valley dam plants, High head diversion plants, Diversion canal plants, Pumped storage plants, Tidal power plants, Environmental considerations, Estimation of hydropower potential, General load curve, Load factor, Capacity factor, Utilization factor, Diversity factor, Water conveyance system; Power canals, Alignment, Design of powercanals, Flumes, Covered conduits and tunnels, Drainage and Ventilation in tunnels. Penstocks; Design considerations.

Recommended Readings:

1. Punmia, Pande, Lal, A. K. Jain; Irrigation Engineering; Laxmi Publications (P) Ltd.
2. P. N. Modi; Irrigation and Water Power Resources Engineering; Standard Book House.
3. R. K. Sharma and T. K. Sharma; Irrigation Engineering; S Chand Publications Pvt. Ltd.
4. R. S. Varshney; Hydropower Structures; Nem Chand and Bros.
5. Basak; Irrigation Engineering; Tata McGraw Hill Publishing Ltd.
6. S. K. Garg; Irrigation Engineering and Hydraulic Structures; Khanna Publishers, Delhi.
7. Larry W. Mayas; Water Resources Engineering; John Wiley and sons.
8. K. R. Arora; Irrigation, Water Power and Water Resources Engineering; Standard Publishers, New Delhi.

Tutorial Exercise:

- Exercise shall include at least four assignment based on above syllabus.
- Submission of Field visit report to a Dam site and any Irrigation Project.

CE 8.2 CONSTRUCTION MACHINERY AND PROJECT MANAGEMENT

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Instruction						
					Th. Duration (Hrs)	Marks					
		L	T	P		TH	S	TW	P	O	Total
CE 8.2	Construction Machinery and Project Management	4	1	2	3	100	25	--	25	--	**150**

Course Objectives:

1. To understand the techniques of construction management.
2. To understand optimal utilisation of resources in construction industries.

Course Outcomes:

The student after undergoing this course will be able to:

1. Apply the knowledge of planning, organising, scheduling, monitoring activities related to manpower, equipment, material, finance and time.
2. Supervise the working and operation of various construction equipments.

UNIT - 1 (16 Hours)

Fundamentals of Construction Management: Fundamental components, Construction industry, Construction projects, Principles of management (Harry Foyal), Modern scientific management, Agencies associated with the construction industries in national development Main causes of project failure, project life cycle. Importance of planning, Scheduling and Controlling projects.

Project Planning Scope: Project clearance procedures and Necessary documentation for major works like dams, Multistoried structures, Ports and Tunnels, Functions and Role of Chief planner and Project management consultants.

UNIT - 2 (16 Hours)

Project Scheduling Scope: Guidelines for drawing project network, Work breakdown structure, Scheduling of bar chart and Preparing construction schedule by bar chart for small projects, Advantages and Limitations of bar chart. Time estimation in CPM, PERT,

RPM (Repetitive Project Modeling) techniques and Analysis, Critical path method calculation. Factors affecting work scheduling, LOB techniques, Precedence network analysis.

Project Management Software: Hands on software in construction scheduling (MSP or Primavera).

UNIT - 3 (16 Hours)

Planning Construction Resources:
Manpower: Necessity, Establishing workers productivity standards, Scheduling construction site workers, Project manpower grouping and Designing workers financial incentive scheme, Important Acts and Labour laws related to construction activity.

Materials: ABC Classification of construction materials, Materials Usage/wastage standards, Materials provisioning process, Planning materials inventory.

Project Construction Equipment: Selecting construction equipment, Classification of major equipment, Earth factor in earthwork, Earth excavating equipment, Earth cutting and Hauling equipment, Earth compacting and Grading equipment, Concreting plant and Equipment, Cranes for materials hoisting, Equipment for dredging, Trenching, Tunnelling and Pile driving.

UNIT - 4 (16 Hours)

Planning Construction Costs and Construction Budgets: Classification of construction costs, Elements and Classification of cost accounting, Breakeven point, Standard 'S' curve forecasting tool, Fund flow v/s cash flow. Structuring responsibility centres, Costs inflation, Escalation and Contingencies, Types of budget, Techniques for budgeting, Budgetary forecasts, Project master budget.

Project Control: Control system framework, Monitoring performance, Resource productivity control, Project time and Cost control basics, Disputes and claims management, Concepts of quality control and its importance for construction work.

Recommended Readings:

1. K. K. Chitkara; Construction Project Management; Tata Mc Graw Hill.
2. B. C. Punmia; Project Planning and Control with PERT and CPM; Laxmi Publications , New Delhi.

3. Gautam V. Desai, Erik W. Larson, Clifford F. Grey; Project Management – The Managerial Process; Tata Mc Graw Hill.
4. Vazirani and Chavdale, Construction management and accounts; Khanna publications – New Delhi.
5. Patrick Charles; Construction Project planning and Scheduling; Pearson.
6. V. K. Raiva; Construction Management Practice; Tata Mac-hill publication, New Delhi.
7. Robert L. Peurifoy; Construction Planning, Equipment and Method; Tata Mc Graw Hill Publishing Ltd.
8. G. D. Oberlender; Project Management for Engineering and Construction; Tata Mc Graw Hill Publishing Ltd.

List of Experiments:

(At least 8 experiments should be conducted from the list of experiments)

1. Carry out a Work Breakdown structure of a sub-Project
2. Prepare of bar chart Schedule for a Sub-Project
3. Draw a Network and identify critical path by CPM
4. Prepare of Line of balance chart for Repetitive works in a Project.
5. Classify the construction Materials into A, B and C classes.
6. List out Construction equipment's and its uses
7. Prepare of a Budget for a sub-Project.
8. Carry out a Case study on Time control methods of a sub-Project.

Tutorial Exercise:

- Exercise shall include at least four assignment based on above syllabus.
- Submission of Field visit report to a construction site.

CE 8.3.1 INDUSTRIAL AND MUNICIPAL WASTE MANAGEMENT

Subject Code	Nomenclature of the Subject	Scheme of Instruction Hrs/Week			Scheme of Instruction						
		L	T	P	Th. Duration (Hrs)	Marks					
						TH	S	TW	P	O	Total
CE 8.3.1	Industrial and Municipal Waste Management	3	--	2	3	100	25	--	--	25	**150**

Course Objectives:

1. To impart knowledge on sources and characteristics of various industrial effluents and Municipal solid wastes and strategies for its prevention and control.
2. To make the students conversant with different aspects of Industrial effluents and municipal solid wastes, their types, sources, generation, storage, collection, transport and Processing.
3. To estimate the pollution and use proper control measures.

Course Outcomes:

The student after undergoing this course will be able to:

1. Have an insight into the pollution from major industries including the sources and characteristics of pollutants, ability to plan minimization of industrial effluents and to design facilities for the processing and reclamation of industrial wastewater.
2. An understanding of the nature and characteristics of municipal solid wastes and the regulatory requirements regarding municipal solid waste management, the ability to plan waste minimization and design storage, collection, transport, processing and disposal of municipal solid waste.
3. Suggest a particular line of treatment or control measures to prevent pollution

UNIT - 1 (12 Hours)

Introduction: Objectives of industrial wastewater treatment, Properties and Characteristics of wastewater. Difference between Industrial and Municipal wastewater. Impact of waste on streams, Stream standards and Effluent standards. Oxygen sag curve, Computation of organic waste loads on stream; Streater Phelps equation, Statement, Application and Problem solving.

UNIT - 2 (12 Hours)

Sampling and Treatment: Types of Sample; Grab, Composite and Integrated samples and Biomonitoring. Primary, Secondary and Tertiary treatments. Pretreatment of industrial waste, Volume reduction, Strength reduction, Neutralization, Equalization and Proportioning. Economic feasibility of joint treatment of raw industrial effluent with municipal sewage.

UNIT - 3 (12 Hours)

Municipal Soild Waste Management: Composition, Segregation and Introduction to scientific landfill treatment method. Collection and Transportation of municipal solid waste. Recycle, Reuse and Disposal of construction waste. Composting; Aerobic, Anaerobic and Vermicomposting.

UNIT - 4 (12 Hours)

Industrial Wastes: Treatment in specific Industries like Distillery, Brewary and Winary, Dairy, Cane sugar, Fertilizer, Pulp and Paper, Pharmaceutical (antibiotics), Pesticides and Petrochemical with their Processes, Characteristics, effects, Treatment by-product recovery and Reuse of treated water with flow chart.

Recommended Readings:

1. S. R. Asolekar and S. J. Arceivala; Wastewater Treatment for Pollution Control; Tata McGraw Hill.
2. G. Tchnobanoglous, H. Theissen and R. Eliassen; Solid Waste Engineering – Principals and Management Issues; McGraw Hill, New York.
3. Peavey, Rowe and Tchnobanoglous; Environmental Engineering; McGraw Hill Co.
4. C. L. Mantell; Solid Waste Management; John Wiley.
5. Government of India; Manual on Municipal Solid Waste Management; CPHEEO, Ministry of Urban Development, New Delhi.
6. M. N. Rao and A. K. Dutta; Wastewater Treatment; Oxford - IBH Publication.
7. W. W. Eckenfelder Jr; Industrial Water Pollution Control; McGraw-Hill Book Company.
8. Nelson Nemerow; Industrial Waste Treatment; Addison Willey New York.

List of Experiments:

(At least 8 experiments should be conducted from the list of experiments)

1. Laboratory analysis of wastewater of any one industry for minimum five different parameters
   (i) Determination of solids (total, dissolved, suspended, organic, inorganic, settleable) in water
   (ii) Determination of pH
   (iii) Determination of turbidity
   (iv) Determination of Alkalinity
   (v) Determination of Chlorides
   (vi) Determination of Biochemical Oxygen Demand (BOD)
   (vii) Determination of Chemical Oxygen Demand (COD)
   (viii) Determination of conductivity.

2. Four assignments one on each unit and one power point presentation on any one topic from the syllabus.

3. Possible field visits to any two above industries and a composting plant / garbage treatment plan or a landfill site.

CE 8.3.2 ADVANCED STRUCTURAL ANALYSIS

Subject Code	Nomenclature of the Subject	Scheme of Instruction Hrs/Week			Scheme of Instruction						
		L	T	P	Th. Duration (Hrs)	Marks					
						TH	S	TW	P	O	Total
CE 8.3.2	Advanced Structural Analysis	3	--	2	3	100	25	--	--	25	**150**

Course Objectives:

1. To develop skills to idealize, formulate, and analyze determinate and indeterminate structures (beams, trusses, and frames) using classical and matrix structural analysis methods.
2. To introduce computer-based applications for the analytical methods as presented.

Course Outcomes:

The student after undergoing this course will be able to:

1. Identify, formulate, and solve engineering problems.
2. Use the techniques, skills, and modern engineering tools necessary for engineering practice.

UNIT - 1 (12 Hours)

Introduction to Matrix Methods of Analysis: Static indeterminacy and Kinematic indeterminacy, Degree of freedom, Coordinate system, Structure idealization stiffness and Flexibility matrices, Suitability element stiffness equations, Elements flexibility equations, Mixed force, Displacement equations; for truss element, Beam element. Transformation of coordinates, Element stiffness matrix and Load vector; Local and Global coordinates

UNIT - 2 (12 Hours)

Matrix Stiffness Method: Matrix from element stiffness matrix, Direct stiffness method, General procedure, Bank matrix, Semi bandwidth, Computer algorithm for assembly by direct stiffness matrix method.

Analysis of Plane Truss: Continuous beam, Plane frame and grids by flexibility methods. Analysis of plane truss; Continuous beam, Plane frame and Grids by stiffness methods.

Special analysis procedures, Static condensation and Sub structuring; Initial and Thermal stresses.

UNIT - 3 (12 Hours)

Dynamic Analysis: Equations of motion, Natural vibration, Dynamic analysis by modal superposition, Direct integration methods. Examples of dynamic analysis.

UNIT - 4 (12 Hours)

Structural Modelling and Computer Software Applications: Modelling of buildings (G+3) structure, Bridges, Typical example problems using any FEM based standard software.

Recommended Readings:

1. William Weaver J. R., James M. Geve; Matrix Analysis of Frames Structures; CBS publications.
2. Ashok K. Jain; Advanced Structural Analysis; Nem Chand and Bros.
3. C. S. Reddy; Basic Structural Analysis; McGraw Hill Education.
4. M. B. Kanchi; Matrix methods of Structural Analysis; Wiley publication.
5. J. Meek; Matrix Structural Analysis; McGraw Hill Education.
6. Amin Ghali, Adam Neville, T.G. Brown; Structural Analysis; CRC press.
7. IRC 6.

List of Experiments:

1. Modelling and analysis of G+3 building.
2. Modelling of two span continuous bridges, Modelling IRC Loading on Bridges.
3. Analysis and interpretation of results for some simple structures.
4. Four assignments one on each unit from the syllabus.

CE 8.3.3 GROUND IMPROVEMENT TECHNIQUES

Subject Code	Nomenclature of the Subject	Scheme of Instruction Hrs/Week			Scheme of Instruction						
		L	T	P	Th. Duration (Hrs)	Marks					
						TH	S	TW	P	O	Total
CE 8.3.3	Ground Improvement Techniques	3	--	2	3	100	25	--	--	25	**150**

Course Objective:

1. To study engineering properties of soft, weak and compressible deposits
2. To learn about emerging trends in ground improvement.
3. To understand principles and methods of ground improvement

Course Outcomes:

The student after undergoing this course will be able to:

1. Select appropriate ground improvement technique considering soil condition, type of structure, environmental aspect and economy
2. Execute various ground improvement techniques

UNIT - 1 (12 Hours)

Introduction: Different types of problematic soils and their geological formation principles of treatment, Loading, Classification of ground modification techniques, Emerging trends in ground improvement.

Treatment of Loose Sands:

Mechanical Stabilization - Shallow and Deep compaction requirements, Principles and methods of soil compaction, Shallow compaction and methods. Properties of compacted soil and Compaction control, Deep compaction and vibratory methods dynamic compaction. Compaction piles, deep compaction, Dynamic compaction, Vibroflot technique, Controlled blasting for compaction.

Hydraulic Modification - Ground improvement by drainage, Dewatering methods, Design of dewatering systems, Preloading, Vertical drains, Vacuum consolidation, Electro-kinetic dewatering, Heating and Freezing methods, Microbial geotechnology.

UNIT - 2 (12 Hours)

Treatment by Admixtures: Cement stabilization and Cement columns, Lime stabilization and Lime columns. Stabilization using bitumen and Emulsions, Stabilization using industrial wastes, Construction techniques and Applications.

Grouting Techniques: Permeation grouting, Compaction technique, Jet grouting, Different varieties of grout materials, Grouting in difficult conditions.

Treatment of Expansive Soils: Lime treatment for expansive soils, Injection method, Lime-columns, Chemical analysis.

UNIT - 3 (12 Hours)

Accelerated Consolidation Methods for Soft Clay Soils: Preloading and the techniques of preloading, Band drains, Consolidation by sand drains, Radial consolidation, Effect of smear zone on radial consolidation, Pre-fabricated drains. Vacuum consolidation, Vibro compaction, Stabilization of soil by vitrification, Ground freezing, Dewatering and Electro kinetics, Accelerated pre-consolidation of soft clay using geosynthetics.

UNIT - 4 (12 Hours)

Insitu Ground Treatment for Slopes: Different types of in situ soil stabilization like soil nails, Rock anchoring, Pre-stressed anchors, etc. Optimum design of nailed slopes, Design methods and Construction techniques. Evaluation of zone of liquefaction in field, Ground improvement techniques for improving liquefaction resistance of soils, Nano-technologies in ground improvement and Site remediation.

Recommended Readings:

1. M. R. Haussmann; Engineering Principles of Ground Modification; Tata McGraw-Hill Inc., USA.
2. Gulati and Datta; Geotechnical Enginnering; Tata Mc Graw Hill.
3. Raj Purushothama; Ground Improvement Techniques; Laxmi Publications.
4. J. E. Bowles; Foundation Analysis and Design; Tata McGraw Hill.
5. M. P. Mooseley and K. Kirsch; Ground Improvement; 2nd Edition, Spon Press, Taylor and Francis Group, London, United Kingdom.

List of Experiments:

(At least 8 experiments should be conducted from the list of experiments)

1. Grain size analysis of soil sample (sieve analysis).
2. Modified Proctor Compaction Test.

3. Coefficient of permeability by constant head and variable head methods.
4. Shear strength of soil by
    a. Direct Shear Test
    b. Unconfined Compression Test
    c. Triaxial Compression Test (undrained)
5. Consolidation Test- Determination of compression index and coefficient of consolidation. .
6. Determination of CBR value
7. Demonstration of miscellaneous equipments such as Augers, Samplers, Rapid Moisture meter, Proctor's needle.
8. Demonstration of Hydrometer Test.
9. Demonstration of Free Swell Index and Swell Pressure Test
10. Demonstration of determination of relative density of sands.
11. Preparing a report on index properties and strength properties of soil

CE 8.3.4 DESIGN OF EARTHQUAKE RESISTANT STRUCTURES

Subject Code	Nomenclature of the Subject	Scheme of Instruction Hrs/Week			Scheme of Instruction						
		L	T	P	Th. Duration (Hrs)	Marks					
						TH	S	TW	P	O	Total
CE 8.3.4	Design of Earthquake Resistant Structures	3	--	2	3	100	25	--	--	25	**150**

Course Objectives:

1. To understand causes and effects of Earthquakes.
2. To learn about analysis of structure subjected to earthquake loads.
3. To study the design of Earthquake resistant structures.
4. To get acquainted with detailing of Earthquake resistant structures.

Course Outcomes:

The student after undergoing this course will be able to:

1. Understand causes and effects of earthquakes.
2. Understand the effects of architectural features on the seismic behavior of structures.
3. Analyse, design and detail members for earthquake resistant structures.
4. Interpret codal provisions.

UNIT - 1 (12 Hours)

Engineering Geology of Earthquakes: Theory of tectonic plates, Faults, Seismic waves. Wave measuring instruments, Strong ground motions, Determination of epicenter, magnitude, Epicentral distances and Focal depth of earthquake, Microzonation, Concept of seismic hazard analysis. Importance of architectural features in earthquake resistant design, Indian seismic codes, Behaviour of masonry structures during earthquakes.

UNIT - 2 (12 Hours)

Introduction to Methods of Analysis: Linear static analysis, Linear dynamic analysis, non-linear analysis, Modal analysis, Response spectrum method. Construction of response spectra. Equations of motion for SDOF and MDOF systems. Mode shapes and Frequencies of MDOF system.

Response of multistoried building subjected to earthquake forces by Equivalent Static Load Method.

Response of multistoried building subjected to earthquake forces by Response Spectrum Method.

UNIT - 3 (12 Hours)

Design of flexural members and compression members for earthquake load cases.

Design of shear wall

Seismic repair, rehabilitation and retrofitting.

UNIT - 4 (12 Hours)

Detailing of beams, columns, footings, beam-column junction as per IS 13920.

Techniques used to reduce effect of earthquake on structures, Base isolation and Various types of dampers.

P-Delta effects, Soil structure interaction.

Recommended Readings:

1. R. L. Wiegel; Earthquake Engineering; Prentice Hall, Inc.
2. James L. Stratta; Manual of Seismic Design; Pearson education Publication.
3. A. K. Chopra; Dynamics of Structures; Pearson Education.
4. Mario Paz; Structural Dynamics; CBS publishers.
5. Pankaj Agarwal, Manish Shrikhande; Earthquake Resistant Design of Structures; PHI Learning Private Limited.
6. S. K. Duggal; Earthquake Resistant Design of Structures; Oxford Publication.
7. Farzad Neaim; Handbook on Seismic analysis and Design of Structure; Springer.
8. IS 1893: Part I-IV and IS 13920.

List of Experiments:

1. To determine the response of structures subjected to earthquake by numerical methods.

2. To analyze, design and drawing of a shear wall.
3. To perform Seismic Analysis, Design, detailing and drawing of multi-storied building using software using various methods.
4. At least four assignments based on the above syllabus.

CE 8.3.5 ADVANCED MATERIALS AND CONSTRUCTION TECHNIQUES

Subject Code	Nomenclature of the Subject	Scheme of Instruction Hrs/Week			Scheme of Instruction						
		L	T	P	Th. Duration (Hrs)	Marks					
						TH	S	TW	P	O	Total
CE 8.3.5	Advanced Materials and Construction Techniques	3	--	2	3	100	25	--	--	25	**150**

Course Objectives:

1. To understand Comparative knowledge of material properties (physical, structural, etc) for most common and advanced building materials.
2. To understand the typical and potential applications of these materials.
3. To understand the relationship between material properties and structural form.
4. To understand the importance of experimental verification of material properties.

Course Outcomes:

The student after undergoing this course will be able to:

1. Know the properties and utilities of advanced materials in construction industry.
2. Get a knowledge of advances in construction techniques.

UNIT - 1 (12 Hours)

Use of Industrial waste in concrete, Manufactured sand, Tests for manufactured sand, SCC, tests for SCC, Mix design for SCC, Silica fume concrete, Light weight concrete, Ferro cement technology.

UNIT - 2 (12 Hours)

Injectable adhesive anchors, Post installed structural rebar, Fiber induced concrete, Ultra-high strength concrete, Use of lightweight steel hollow sections, Fiber rebar , Construction chemicals, Injectable mortars, Latest grades of steel rebar, Slip forms, Steel shuttering, PVC shuttering, Tubular shuttering, Various construction chemicals and their uses.

UNIT - 3 (12 Hours)

Rehabilitation studies of various structures and types of defects, Seismic damages of buildings and their retrofitting techniques, Restoration of buildings, Repairs to overcome

various structural defects, Drilling and Demolition techniques, Pre-tensioning and Post-tensioning methods.

UNIT - 4 (12 Hours)

Methods of producing shell roof structures, Sandwiched shell roof structures.

Recommended Readings:

1. G. S. Ramaswamy; Design and Construction of Shell Roofs; Tata McGraw-Hill.
2. Robert Leroy Peurifoy, Clifford J. Schexnayder; Construction Planning, Equipment, and Methods; MGH Publications Delhi.
3. Mohamed El-Reedy; Advanced Materials and Techniques for Reinforced Concrete Structures; CRC Press New Delhi.
4. Michael N. Fardis; Innovative Materials and Techniques in Concrete Construction: ACES Workshop; Springer, Newyork.
5. Purushothama Raj; Building Construction Materials and Techniques; Pearson, New Delhi.
6. Product manuals of Advance materials.
7. CPWD Handbook on Rehabilitation and Retrofitting.

List of Experiments:

1. To carry out a mix design and testing of SCC.
2. To carry out a mix design and testing of foam concrete.
3. To carry out a mix design and testing of silica fume concrete.
4. To carry out a strength test of CFRP bars.
5. To carry out tests on hardened concrete.
6. To carry out a test on crack width measurement.
7. Report on visit to a site to observe pre-tensioning.
8. Report on visit to a site to observe post-tensioning.

CE 8.4.1 ADVANCED PRE-STRESSED CONCRETE

Subject Code	Nomenclature of the Subject	Scheme of Instruction Hrs/Week			Scheme of Instruction						
					Th. Duration (Hrs)	Marks					
		L	T	P		TH	S	TW	P	O	Total
CE 8.4.1	Advanced Pre-stressed Concrete	3	--	2	3	100	25	--	--	25	**150**

Course Objectives:

1. To impart the knowledge of pre-stressed concrete.
2. To design pre-stressed concrete elements.

Course Outcomes:

The student after undergoing this course will be able to:

1. Know the methods of pre-stressing, advantages of pre-stressing concrete, the losses involved.
2. Design methods for pre-stressed concrete elements under codal provisions.

UNIT - 1 (12 Hours)

Introduction: Theory and Behaviour, Basic concepts, Advantages, Materials required, Systems and Methods of prestressing, Analysis of sections, Stress concept, Strength concept, Load balancing concept, Effect of loading on the tensile stresses in tendons, Effect of tendon profile on deflections, Factors influencing deflections, Calculation of deflections, Short term and Long term deflections, Losses of prestress, Estimation of crack width.

UNIT - 2 (12 Hours)

Design Concepts: Flexural strength, Simplified procedures as per codes, Strain compatibility method, Basic concepts in selection of cross section for bending, Stress distribution in end block, Design of anchorage zone reinforcement, Limit state design criteria, Partial pre-stressing, Applications.

UNIT - 3 (12 Hours)

Circular Pre-Stressing: Design of pre-stressed concrete tanks, Pipes.

UNIT - 4 (12 Hours)

Composite Construction: Analysis for stresses, Estimate for deflections, Flexural and Shear strength of composite members, General aspects, Pretensioned prestressed bridge decks, Post tensioned prestressed bridge decks, Principles of design only.

Recommended readings:

1. N. Krishna Raju; Pre-stressed Concrete; Tata McGraw Hill Company, New Delhi.
2. S. K. Mallic and A. P. Gupta; Pre-stressed Concrete; Oxford and IBH publishing Co. Pvt. Ltd.
3. N. Rajagopalan; Pre-stressed Concrete; Alpha Science, 2002.
4. G. S. Ramaswamy; Modern Pre-stressed Concrete Design, Arnold Heinimen, New Delhi.
5. T. Y. Lin; Design of Pre-stressed Concrete Structures; Asia Publishing House, Bombay.
6. David A. Sheppard, R. William and Philips; Plant Cast Precast and Pre-stressed Concrete – A Design Guide; McGraw Hill, New Delhi.

List of Experiments:

1. Four assignments one on each unit from the above syllabus.
2. Possible field visit to construction site to understand pre-stressed concept.

CE 8.4.2 GREEN BUILDING DESIGN

Subject Code	Nomenclature of the Subject	Scheme of Instruction Hrs/Week			Scheme of Instruction						
		L	T	P	Th. Duration (Hrs)	Marks					
						TH	S	TW	P	O	Total
CE 8.4.2	Green Building Design	3	--	2	3	100	25	--	--	25	**150**

Course Objectives:

1. To create interest among students in green buildings and motivate them to acquire knowledge in this field.
2. To gain basic knowledge of green buildings and related terminology.

Course Outcomes:

The student after undergoing this course will be able to:

1. Understand concepts of green building, including water, energy, resource efficiency, and waste reduction.
2. Analyze energy audits, conservation measures, codes and standards, and daylight simulation/modeling tools for various building types.

UNIT – 1 (12 Hours)

Introduction: Definition of green buildings, Terminologies, Objectives, Benefits, Rating systems of IGBC, Green concepts in various building types viz., Industrial, Residential, Commercial complexes, Educational institutes, Global trends in green buildings, Tangible and Intangible Benefits.

UNIT – 2 (12 Hours)

IGBC Rating System: Introduction to rating systems, IGBC rating systems, Understanding of green building measures in the areas of Site Preservation, Energy Efficiency, Materials, Water conservation and Indoor air quality.

Tools and Resources: Introduction to quantification and Design calculations, Energy simulation basics, Fundamentals of lighting simulation, Economics of building green

UNIT – 3 (12 Hours)

Basic Knowledge of Materials, Systems and Technologies: Fundamentals of HVAC, Innovative cooling technologies, Lighting, Building Management Systems, Rain water harvesting, Water treatment and Recycling techniques, Building materials, Paints, Glass and Glazing, Insulation, Interiors, Landscaping.

UNIT – 4 (12 Hours)

Incentives and Policies: Carbon trust, Carbon credit, Returns on investments, Savings Policies towards electrical power in India. Tax credits, Grants.

Recommended Reading:

1. Anthony Floyd; Green Buildings: Professional Guide to Concepts, Codes and Innovations; Cenage Learning India Pvt. Ltd., New Delhi.
2. Kweku K. Bentil and Carl W. Linde; Green Buildings: Project Planning and Cost Estimating; John Wiley and Sons.
3. Ross Spiegel and Dru Meadows; Green Building Materials: A Guide to Product Selection and Specification; John Wiley and Sons.
4. Seymour Jurmul; Guide to Energy Conservation: Energy Planning for Buildings; McGraw-Hill.
5. IGBC Green Homes – Detailed Reference Guide; IGBC, Hyderabad.
6. Brenda and Robert Vale; Green Architecture: Design for sustainable future; Thames and Hudson Ltd.
7. Proceedings of various green conferences organized by IGBC is available free to download on its website.

List of Experiments:

1. Report on how to convert existing building into green building (paper presentation) and Study the benefits of green buildings.
2. Case study of a green building and prepare a group report under the guidance of an IGBC AP.
3. Mock examination

CE 8.4.3 REPAIR AND REHABILITATION OF STUCTURES

Subject Code	Nomenclature of the Subject	Scheme of Instruction Hrs/Week			Scheme of Instruction						
		L	T	P	Th. Duration (Hrs)	Marks					
						TH	S	TW	P	O	Total
CE 8.4.3	Repair and Rehabilitation of Structures	3	--	2	3	100	25	--	--	25	**150**

Course Objectives:

1. To understand the causes of deterioration of concrete structures.
2. To understand different strategies for repair and rehabilitation of structures.

Course Outcomes:

The student after undergoing this course will be able to:

1. Identify the cause of deterioration of structures.
2. Understand the different techniques for condition assessment of structures for identifying damages in structures.
3. Select repair material, retrofitting strategy suitable for distress.

UNIT - 1 (12 Hours)

Introduction: Cause of deterioration of concrete structures, Overview of current repair practices. Diagnostic methods and Experimental investigations; Concrete strength assessment by Rebound hammer tests, Ultrasonic pulse velocity tests, Penetration resistance tests, Pull out tests and core sampling tests. Corrosion potential assessment by half-cell potentiometer tests and Resistivity measurements.

UNIT - 2 (12 Hours)

Influence on Serviceability and Durability: Effects due to temperature, Chemicals, Design and Construction errors, Corrosion mechanism. Effects of cover thickness and Cracking.

Methods of Corrosion Protection: Cathodic protection, Coatings, Corrosion inhibitors.

UNIT - 3 (12 Hours)

Selection of Repair Materials: Repair materials for concrete, Essential parameters for repair materials; Strength and Durability aspects, Costs and Suitability aspects.

UNIT - 4 (12 Hours)

Rehabilitation techniques: Important factors to be considered while selecting repair and Rehabilitation methods. Rehabilitation Techniques; Guniting, Shortcreting, Mortar repair for cracks, Reinforcement replacement, Resin/ Polymer modified slurry injection, Ferro cement jacketing, RCC jacketing, Plate bonding technique, Fiber wrapping technique. Repair and Strengthening of beams and columns.

Recommended Readings:

1. Sidney, M. Johnson; Deterioration, Maintenance and Repair of Structures; McGraw hill.
2. Denison Campbell, Allen, Harold Roper; Concrete Structures – Materials, Maintenance and Repair; Longman Scientific and Technical.
3. R. T. Allen, S. C. Edwards; Repair of Concrete Structures; Blakie and Sons.
4. R. N. Raiker; Learning for Failure from Deficiencies in Design, Construction and Service; RandD Center (SDCPL).
5. CPWD handbook on repair and rehabilitation of RCC buildings, CPWD, New Delhi, 2002.

List of Experiments:

1. At least 4 assignments should be submitted based on the syllabus.
2. Report of a case study involving damage identification, repair and restoration techniques recommended.

CE 8.4.4 PAVEMENT DESIGN

Subject Code	Nomenclature of the Subject	Scheme of Instruction Hrs/Week			Scheme of Instruction						
					Th. Duration (Hrs)	Marks					
		L	T	P		TH	S	TW	P	O	Total
CE 8.4.4	Pavement Design	3	--	2	3	100	25	--	--	25	**150**

Course Objectives:

1. To study about the types and components of pavements.
2. To study the design aspects of flexible and rigid pavements.

Course Outcomes:

The student after undergoing this course will be able to:

1. Identify the usage of various materials to be used for road construction.
2. Understand the various methods of pavement construction.
3. Understand and apply knowledge to reconstruction and rehabilitation of pavements.

UNIT - 1 (12 Hours)

Fundamental Principles: Pavement types, Wheel loads and Design factors, Stresses in flexible and Rigid pavements, Determining ESWL for highways and Airports, ESWL factors, Effects on pavements due to climate and Environment, Pavement costs, Economic analysis

Properties of pavement components and Material characterization; Soil classification and Application, Types of tests; Plate load test, Triaxial Test, CBR Test, Stabilometer and Cohesiometer tests; Tests for bituminous mixtures and Concrete, Resilient modulus test.

UNIT - 2 (12 Hours)

Pavement Design: Design of flexible pavements for airports, CBR Method, FAA method; Design of flexible pavements for highways; CBR Method, IRC method, Limiting shear failure method, Limiting deflection method, Regression method based on pavement performance, Mechanistic method for bituminous pavement design, AASHO design method.

Design of Rigid Airport and Highway Pavements: Modulus of subgrade reaction, Design charts, Westergaard's equations for load and Temperature stresses; Examples; Design of slab thickness only as per IRC: 58-2002, Factors affecting design and Performance, AASHTO method, PCA method; Joint and Reinforcement requirements.

UNIT - 3 (12 Hours)

Pavement Design and Construction: WBM Roads, WMM roads, Bituminous and Cement concrete roads, Design of bituminous and Cement concrete mixes.

Soil and Base Stabilization: Mechanics of stabilization, Types of stabilisation, Construction and Field control, General properties of soil aggregate mixture.

Types of Bases and Sub-Bases: Macadam base courses, Cement treated bases, Asphalt treated bases, Base and Sub base drainage.

UNIT - 4 (12 Hours)

Pavement Evaluation and Rehabilitation: Pavement distress, Types and Causes, Condition and Evaluation surveys; Methods of measuring condition, Skid resistance.

Strengthening Existing Pavements: Principles of maintenance, Typical maintenance procedures, Deflection measurement as an evaluation tool, Benkelman beam, Static load deflection test procedure, Creep load deflection test procedure, Correction for temperature and Seasonal variations; Maintenance of shoulders.

Structural Evaluation of Rigid Pavements: Direct load test method, Indirect reverse design method, Determination of pavement structural strength.

Overlays: Overlays for airport and Highway pavements, Types of overlays, Design.

Recommended Readings:

1. E. J. Yoder, M. W. Witczak; Principles of Pavement Design; Wiley Publication.
2. S. K. Sharma; Principles, Practice and Design of Highway Engineering; S Chand and Company.
3. Kerbs and Walkes; Highway Materials; McGraw Hill Book Co.
4. Ministry of Surface, Road, Transport and Highway; Specifications for Road and Bridge works.

5. Partha Chakroborty and Animesh Das; Principles of Transportation Engineering,; Prentice Hall of India, New Delhi.

List of Experiments:

1. To design job mix for surface course from the given sample of aggregates.
2. To design job mix for base course from given sample of aggregates.
3. To conduct CBR test for the given subgrade material.
4. To determine preliminary tests on aggregates for road construction.
5. To determine preliminary tests on Bitumen used in road construction.
6. To determine binder content from the given sample.
7. Report of the field visit to a hot mix plant.

CE 8.4.5 DESIGN OF REINFORCED CONCRETE BRIDGES

Subject Code	Nomenclature of the Subject	Scheme of Instruction Hrs/Week			Scheme of Instruction						
		L	T	P	Th. Duration (Hrs)	Marks					
						TH	S	TW	P	O	Total
CE 8.4.5	Design of Reinforced Concrete Bridges	3	--	2	3	100	25	--	--	25	**150**

Course Objectives:

1. To make the students familiar with the IRC classes of loading for detailed calculation of loadings and design of various components.
2. To design the basic components of bridge structures like bridge deck slabs longitudinal girders transverse girders, piers and well foundations.

Course Outcomes:

The student after undergoing this course will be able to:

1. Understand the basic definitions, types, and components of bridges.
2. Design super-structures of bridges.
3. Detail the reinforcement as per the design.
4. Interpret Codal Provisions.

UNIT - 1 (12 Hours)

General Types and Classification of Bridges: Arch, Slab, Box Culvert, Beam and Slab, Plate Girder, Composite Bridges, Components of bridges, Investigation and Planning for bridges, Design flood discharge, Linear waterways.

Loads for Bridges: IRC loadings, Dead load, Live load, Impact load, Wind load, Longitudinal and Horizontal forces.

UNIT - 2 (12 Hours)

Design of Concrete Bridges: Superstructure, Design of box culvert, Introduction, Design method and Design example.

Design of Beam and Slab Bridges: Design of interior panel of slab. Pigeauds method, design of longitudinal girder, Calculation of longitudinal moment design example.

Design of Reinforced Concrete Solid Slab Bridges: General design features, Effective width method. Simply supported slab bridge analysis and Design.

UNIT - 3 (12 Hours)

Stability Analysis of Abutments and Piers: General scour at abutments and Piers, Grip length, Types of abutments and Piers and Stability of abutments and Piers for different loading combinations.

UNIT - 4 (12 Hours)

Bridge Foundations: Types of bridge foundations, Stability of different types of foundations, Design of shallow, Pile, Well foundations and Pneumatic caissons.

Recommended Readings:

1. M. G. Aswani, V. N. Vazirani, M. M. Ratwani; Design of Concrete Bridges; Khanna Publ.
2. T. R. Jagadeesh, M. A. Jayaram; Design of Bridge Structures; Phi Learning Pvt. Ltd, New Delhi.
3. D. J. Victor; Essential of Bridge Engineering; Oxford and IBH Publishing Co., New Delhi.
4. S. Ponnuswamy; Bridge Engineering; Tata McGraw Hill.
5. N. Krishna Raju; Bridge Engineering; Oxford and IBH Publishing Co., New Delhi.
6. IRC-6, IRC-22, IRC-37.

List of Experiments:

1. Manual Design, detailing and drawing of a Culvert Bridge
2. Manual Design, detailing and drawing of a beam and slab type of Bridge
3. Design, detailing and drawing of a Culvert Bridge using Software
4. Design, detailing and drawing of a beam and slab type of Bridge using software
5. Design, detailing and drawing of a bridge Abutment and pier.
6. Design, detailing and drawing of different types of bridge foundations.
7. At least 4 assignments should be submitted based on the syllabus.

CE 8.5 PROJECT

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Instruction						
		L	T	P	Th. Duration (Hrs)	Marks					
						TH	S	TW	P	O	Total
CE 8.5	Project	--	--	8	--	--	--	75	--	75	**150**

Guidelines for Project Work:

1. Students shall carry out the required experimental / field/ numerical / analysis/ design / any other work related to the project during the semester.
2. Students shall perform the project work using institute / industry facilities.
3. Students shall maintain a project book including observations, readings, calculations and all other relevant data related to the project.
4. Student shall continuously update the project book and submit the same to the guide.

TERM WORK:

Project Report: It is expected to show clarity of thought and expression, critical appreciation of the existing literature, and analytical, computational, experimental aptitudes of the student through project report.

The Project report shall be submitted in a standard format and shall consist of the following:

a. Statement of problem
b. Objective and Scope of the study
c. Literature review
d. Methodology
e. Results and Discussions
f. Conclusions
g. References

Review:

Regular review to assess the progress of the project work will be conducted by the Guide. Students shall submit final project report to the department in the form of hard and soft copy after answering the final examination.