

M.D. UNIVERSITY, ROHTAK

(NAAC Accredited 'A+' Grade)

SCHEME OF STUDIES AND EXAMINATION

B.TECH (Civil Engineering)

SEMESTER 5th AND 6th

Scheme effective from 2020-21

COURSE CODE AND DEFINITIONS:

Course Code	Definitions
L	Lecture
T	Tutorial
P	Practical
BSC	Basic Science Courses
ESC	Engineering Science Courses
HSMC	Humanities and Social Sciences including Management courses
PCC	Professional Core Courses
LC	Laboratory Courses
MC	Mandatory Courses
PT	Practical Training
S	Seminar
TH	Theory
Pr	Practical

General Notes:

1. Mandatory courses are non credit courses in which students will be required passing marks in internal assessments.
2. Students will be allowed to use non programmable scientific calculator. However, sharing of calculator will not be permitted in the examination.
3. Students will be permitted to opt for any elective course run by the department. However, the department shall offer those electives for which they have expertise. The choice of the students for any elective shall not be binding for the department to offer, if the department does not have expertise. To run the elective course a minimum of 1/3rd students of the class should opt for it.

Scheme of Studies and Examination
B.TECH (Civil Engineering) – 5th Semester
w.e.f. 2020-21

Sr. No.	Course Code	Course Title	Hours per Week	Contact Hours per Week	Credit	Examination Schedule (Marks)				Duration of Exam (Hours)
			L-T-P			Internal Assessment	External Examination	Practical	Total	
1.	PCC-CE-301-G	Hydrology and Water Resource Engineering	2-1-0	3	3	25	75	-	100	3
2.	PCC-CE-303-G	Highway Engineering-I	2-1-0	3	3	25	75	-	100	3
3.	PCC-CE-305-G	Soil Mechanics	3-1-0	4	4	25	75	-	100	3
4.	PCC-CE-307-G	Water Supply and Treatment	2-1-0	3	3	25	75	-	100	3
5.	PCC-CE-309-G	Design of Steel Structure	3-1-0	4	4	25	75	-	100	3
6.	PCC-CE-311-G	Engineering Geology	2-1-0	3	3	25	75	-	100	3
7.	LC-CE-313-G	Highway Engineering –I Lab	0-0-2	2	1	25	-	25	50	3
8.	LC -CE-315-G	Soil Mechanics Lab	0-0-2	2	1	25	-	25	50	3
9.	LC -CE-317-G	Design of Steel Structure Drawing Lab	0-0-2	2	1	25	-	25	50	3
10.	LC -CE-319-G	Engineering Geology Lab	0-0-2	2	1	25	-	25	50	3
11.	PT-CE-321-G	Survey camp	-	-	2	25	-	25	50	-
12.	PT-CE-323-G	Practical Training-I	-	-	-	-	-	-	* Refer note 1	
		TOTAL			26				850	

Note:

- The evaluation of Practical Training-I will be based on seminar, viva-voce, report submitted by the students. According to performance, the students are awarded grades A, B, C, F. A student who is awarded 'F' grade is required to repeat Practical Training.

Excellent: A; Good : B; Satisfactory: C; Not Satisfactory: F.

Scheme of Studies and Examination
B.TECH (Civil Engineering) – 6th Semester

w.e.f. 2020-21

Sr. No.	Course Code	Course Title	Hours per Week	Contact Hours per Week	Credit	Examination Schedule (Marks)				Duration of Exam (Hours)
			L-T-P			Class work	Theory	Practical	Total	
1.	PCC-CE-302-G	Irrigation Engineering	3-1-0	4	4	25	75	-	100	3
2.	PCC-CE-304-G	Foundation Engineering	3-1-0	4	4	25	75	-	100	3
3.	PCC-CE-306-G	Highway Engineering-II	3-1-0	4	4	25	75	-	100	3
4.	-	*Elective-I	2-1-0	3	3	25	75	-	100	3
5.	-	**Elective-II	3-1-0	4	4	25	75	-	100	3
6.	LC-CE-308-G	Environmental Engineering Lab.	0-0-2	2	1	25	-	25	50	3
7.	LC-CE-310-G	Foundation Engineering lab	0-0-2	2	1	25	-	25	50	3
8.	LC-CE-312-G	Highway Engineering-II Lab.	0-0-2	2	1	25	-	25	50	3
9.	LC-ESC-314-G	Computer aided Civil Engineering Design	1-0-2	3	2	25	-	25	50	3
		TOTAL			24			700		

	Course Code	Course Title
*Elective -I	PEC-CEEL -302 G	1. Waste Water Treatment
	PEC-CEEL -304 G	2. Air & Noise Pollution Control
	PEC-CEEL -306 G	3. Environmental Impact Assessment
**Elective -II	PEC-CEEL -308 G	1. Advanced Concrete Structure
	PEC-CEEL -310 G	2. Pre-Stressed Concrete
	PEC-CEEL -312 G	3. Repair & Rehabilitation Of Structure

Note:

- Each student has to undergo practical training of 6 weeks during summer vacation after 6th semester and its evaluation shall be carried out in 7th Semester.
- Choose any one from Elective-I
- Choose any one from Elective-II

HYDROLOGY AND WATER RESOURCE ENGINEERING			
Course Code	PCC-CE-301-G	External marks:	75
Credits	3	Internal marks:	25
L-T-P	2-1-0	Total marks:	100
		Duration of Examination:	3 hrs

Course Objectives

- To provide knowledge in the hydrological cycle, precipitation, evapotranspiration, infiltration and its measurements.
- To understand the physics of translate of rainfall into runoff modelling of various runoff techniques.
- To estimate the floods.
- To develop ability to apply the analytical and numerical techniques to ground and surface water models.
- To understand hydrographs and its methods.

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

COURSE CONTENT

Unit-I

Module 1: Introduction

Hydrologic Cycle, Water-Budget Equation, History of Hydrology and its Application in Engineering, World Water Balance, Sources of Hydrological Data.

Module 2: Precipitation

Forms of Precipitation, Characteristics of Precipitation in India, Measurement of Precipitation, Rain Gauge Network, Mean Precipitation over an Area, Depth Area-Duration Relationships, Frequency of Point Rainfall, Intensity-Duration-Frequency Curves, Probable Maximum Precipitation (PMP), Rainfall Data in India.

Unit-II

Module 3: Hydrological Abstractions

Evaporation Process, Evaporimeters, Analytical Methods of Evaporation Estimation, Reservoir Evaporation and Methods for its Reduction, Evapotranspiration and its Measurement, Evapotranspiration Equations, Potential Evapotranspiration over India, Actual Evapotranspiration, Interception, Depression Storage, Infiltration Process, Initial Loss, Infiltration Capacity, Factors Affecting Infiltration, Measurement of Infiltration, Infiltration Indices.

Module 4: Runoff

Types of Runoff, Runoff Characteristics of Streams, Runoff Volume, Factor Affecting Runoff, Rainfall-Run off Relationships, Estimation of Runoff, SCS-CN Method of Estimating Runoff Volume, Flow Duration Curve, Flow-Mass Curve, Measurement of Stage of Runoff by-Staff Gauge,

Wire Gauge, Automatic Stage Recorder and Stage Hydrograph; Stream Flow Measurement by Direct and Indirect Methods.

Unit-III

Module 5: Hydrograph

Discharge Hydrograph, Components and Factors Affecting Shape of Hydrograph, Effective Rainfall, Base Flow Separation, Unit Hydrograph(UH)-Definition, Assumptions and its Derivation; Unit Hydrograph of Different Durations, Use and Limitations of UH, Snyder`S Synthetic UH

Module6: Floods and its Estimation

Introduction to Floods, Estimation of Floods by: Rational Methods, Empirical Formulae, Unit Hydrograph Technique, Flood Frequency Studies- Gumbel`s Method, Graphical Method.

Unit-IV

Module 7: Water Resource Planning-I

Role of Water in National Development, Water Resources and their Assessment , Planning Process, Environmental Consideration in Planning, System Analysis in Water Planning, Common Issues in Project Planning.

Module 8: Water Resource Planning-II

Functional Requirements in Multipurpose Projects, Multipurpose Planning, Basin Wise Planning, Long Term Planning, Reservoir Planning-Dependable Yield, Sedimentation in Reservoir, Reservoir Capacity, Empirical-Area Reduction Method.

Course outcomes

At the end of the course, the students will be able to:

- Demonstrate the concepts of hydrograph, unit hydrograph and flood estimation.
- Estimate the hydrological parameters.
- Carry out statistical and probability analysis of hydrological data.
- Demonstrate the concepts of hydrological systems.
- Gain the basic knowledge of water resource planning.

References:

- Engineering Hydrology by K.Subramanya.
- Hydrology by H.M.Raghunath.
- Water Resources Engineering by Linseley and Franzini
- Optimisation Theory and Applications by S.S.Roy
- Water Resources Systems Planning & Economics by R.S.Varshney.

HIGHWAY ENGINEERING-I			
Course Code	PCC-CE-303-G	External marks:	75
Credits	3	Internal marks:	25
L-T-P	2-1-0	Total marks:	100
		Duration of Examination:	3 hrs

Course Objectives

- To understand the importance of transportation and characteristics of road transport.
- To know about the history of highway development, surveys and classification of roads.
- To study the geometric design of highways.
- To study about traffic characteristics and design of intersections.
- To know about the pavement materials and design.
- To know about the different type of bituminous material and design.

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

COURSE CONTENT

Unit-I

Urban, Rural Roads and their Cross-Sections, Design of Cross Section Elements- Right of Way, Width Considerations, Roadway, Shoulders, Kerbs Traffic Barriers, Medians, Frontage Roads; Facilities for Pedestrians, Bicycles, Buses and Trucks, Traffic Separators and Road Margin, Design of Sight Distances, IRC Recommended Values.

Module 1: Introduction

Modes of Transportation, History of Road Development, Scope of Highway Engineering, Road Development Plans in India, PMGSY and other Highway Projects, Classification of Highways, Locations and Functions, Road Patterns.

Module 2: Highway Development and Planning

Necessity and Significance of Highway Planning, Highway Alignment and Surveys, Factors Influencing Highway Alignment, Engineering Surveys for Alignment, Conventional and Modern Methods of Highway Alignments.

Unit-II

Module 3: Highway Geometric Design

Urban, Rural Roads and their Cross-Sections, Design of Cross Section Elements- Right of Way and Width Considerations, Roadway, Shoulders, Kerbs Traffic Barriers, Medians, Frontage Roads; Facilities for Pedestrians, Bicycles, Buses and Trucks, Traffic Separators and Road Margin, Design of Sight Distances, IRC Recommended Values.

Module 4: Design of Horizontal and Vertical Alignment

Super-Elevation and its Design, Extra-Widening, Radius of Circular Curves, Length of Transition Curves, Gradient, Summit and Valley Curves, Introduction to Software like MXROAD.

Unit-III

Module 5: Highway Material: Soil and Aggregate

Subgrade Soil and its Characteristics, Compaction Methods, Evaluation of Soil Strength by Different Tests, Aggregates and their Characteristics, Various Tests on Aggregates, IRC/IS Specifications for Suitability of Aggregates.

Module 6: Highway Material: Bituminous Materials and Bituminous Mixes

Bitumen: Origin, Preparation, Properties and their Testing Methods, Bituminous Road Binders: Requirements Constitution, Selection Criterion for Different Binders, Bituminous Emulsions and Cutbacks: Preparation, Characteristics, uses and their Tests. Bituminous Mixes: Mechanical Properties and Characteristics, Bituminous Mix Design: Methods, Performance-Based Bitumen Specifications, Polymers and Rubber Modified Bitumen in Bituminous Mixes, Waste Plastic in Bituminous Mixes.

Unit-IV

Module 7: Traffic Engineering and Control

Traffic Characteristics, Traffic Studies and their Presentation, Traffic Capacity Studies, PCU and Axle Load Survey, Intersections Design, Design of Sign and Signals, Parking and Accident Studies, Highway Safety Measures.

Module 8: Intelligent Transportation Systems (ITS)

Objectives of Intelligent Transportation Systems, Historical Background, Benefits of ITS, Data Collection Techniques for ITS-Detectors, Automatic Vehicle Location, Automatic Vehicle Identification, Geographic Information Systems and Video Data Collection.

Course Outcomes

At the end of the course, the students will be able to:

- Carry out surveys involved in planning and highway alignment.
- Design cross-section elements, sight distance, horizontal and vertical alignment.
- Implement traffic studies, traffic regulations and control, and intersection design.
- Determine the characteristics of pavement materials.

References:

- Khanna, S.K. and Justo, C.E.G., Veeraragavan A., “Highway Engineering”, Nem Chand & Bros.
- Khanna, S.K. and Justo, C.E.G., “Highway Material Testing Manual”, Nem Chand & Bros.
- Kadiyali, L.R., “Traffic Engineering and Transportation Planning”, Khanna Publishers.
- G.V.Rao, Principles of Transportation and Highway Engg, Tata McGraw Hill Pub.

SOIL MECHANICS			
Course Code	PCC-CE-305-G	External marks:	75
Credits	4	Internal marks:	25
L-T-P	3-1-0	Total marks:	100
		Duration of Examination:	3 hrs

Course Objectives:

- To provide Civil Engineering students with the basic knowledge regarding soil formation and composition.
- To explain the importance of three phase system of soil and how soil is properties estimated using three phase system.
- To impart knowledge on the various factors governing the Engineering behaviour of soils and carry out soil classification.
- To explain role of water in soil behaviour and how soil stresses, permeability and quantity of seepage are estimated.
- To determine shear parameters and stress changes in soil due to foundation loads.
- To estimate the magnitude and time-rate of settlement due to consolidation.

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

COURSE CONTENT

Unit-I

Module 1: Soil Formation and its Basic Soil Properties

Scope of Soil Mechanics, Types of Soil, Origin of Soil and its Formation, Inter-Particle Forces, Soil Structure and Fabric, Major Soil Deposits of India, Three Phase System, Weight-Volume Relationships, Index Properties, Particle Shape and Size, Grain Size Analysis: Sieve Analysis and Hydrometer Analysis; Grain Size Distribution Curves, Consistency of Soils: Sensitivity, Thixotropy, Activity; Consistency Limits and their Determination.

Module 2: Classification and Permeability of Soils

Necessity of Classification, Classification on the Basis of Grain Size and on the Basis of Plasticity, Plasticity Chart, Textural Classification, Unified Soil Classification, IS Classification System Soil. Permeability, Darcy's Law and its Validity, Discharge Velocity and Seepage Velocity, One Dimensional Flow, Factors Affecting Permeability, Laboratory and Field Determination of Permeability, Indirect Methods, Permeability of Stratified Deposits.

Unit-II

Module 3: Effective Stress Concept

Principle of Effective Stress, Effective Stress under Hydrostatic Conditions and Under Hydro-Dynamic Conditions, Effective Stress in The Zone of Capillary Rise, Seepage Pressure, Quicksand Condition, Seepage Through Soil: Two Dimensional Flow, Flownets, Properties and Utilities of Flownet, Uplift Pressure, Piping, Protective Filter.

Module 4: Compressibility and Compaction

Definitions, Role of Moisture and Compactive Effort in Compaction, Moisture Density Relationship, Compaction in Laboratory and Field Conditions, Compactive Effect on Soil Properties, Compaction of Cohesionless Soils, Moderately Cohesive Soils and Clays, Field Control of Compaction.

Unit-III

Module 5: Vertical Stress below Applied Loads

Boussinesq's Equation, Vertical Stress Distribution Diagrams, Pressure Bulb, Vertical Stress Beneath Loaded Areas, Newmark's Influence Chart, Westergaard's Analysis, Contact Pressure, Approximate Stress Distribution Methods for Loaded Areas.

Module 6: Consolidation

Consolidation Process and its Types, Components of Total Settlement, One-Dimensional Consolidation Test, Typical Void Ratio-Pressure Relationships for Sands and Clays, Consolidation Parameters, Normally Consolidated and Over Consolidated Clays, Casagrande's Graphical Method of Estimating Pre-Consolidation Pressure, Terzaghi's Theory of One- Dimensional Consolidation, Determination of Coefficients of Consolidation, Time Rate of Consolidation.

Unit-IV

Module 7: Shear Strength

Mohr Stress Circle, Mohr-Coulomb Failure-Criterion, Relationship Between Principal Stresses at Failure, Drainage Conditions, Shear Strength Parameters and their Determination, Advantages and Disadvantages of Different Shear Tests, Shear Strength Characteristics of Clay and Sand, Partially Saturated Soils.

Module 8: Earth Pressure

Types of Lateral Earth Pressure, Rankine's Active, Passive States of Plastic Equilibrium and Rankine's Theory, Coulomb's Wedge Theory, Coulomb's Active and Passive Earth Pressure Theory, Culmann's Graphical Construction.

Course Outcomes

At the end of the course, the students will be able to:

- Solve three phase system problems.
- Able to carry out soil classification.
- Solve any practical problems related to soil stresses estimation, permeability and seepage including flow net diagram.
- Estimate the stresses under any system of foundation loads.
- Solve practical problems related to consolidation settlement and time rate of settlement.

References:

- Soil Mechanics and Foundation Engineering by K. R. Arora, Standard Publishers Distributors, N. Delhi
- Soil Mechanics and Foundations by B. C. Punmia, Ashok Kumar Jain and Arun Kumar Jain; Laxshmi Publications (P) Ltd, N. Delhi.
- Basic and Applied Soil Mechanics by Gopal Ranjan, ASR Rao, New Age International (P) Ltd., N. Delhi.

- Soil Engineering. in Theory and Practice, Vol .I, Fundamentals and General Principles by Alam Singh, CBS Publications, N.Delhi.
- Engineering Properties of Soils by S.K.Gulati, Tata-Mcgraw Hill,N.Delhi.
- Geotechnical Engineering. by P. Purshotam Raj, Tata Mcgraw Hill.
- Principles of Geotechnical Engineering by B.M. Das, PWS KENT, Boston.

WATER SUPPLY AND TREATMENT			
Course Code	PCC-CE-307-G	External marks:	75
Credits	3	Internal marks:	25
L-T-P	2-1-0	Total marks:	100
		Duration of Examination:	3 hrs

Course Objectives

- To quantify the water demands and its variations.
- To analyze the different characteristics of water.
- To study the different units of treatment.
- To deal with water supply and water distribution to consumers.
- To develop basic knowledge about the water pollution and its control.

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

COURSE CONTENT

Unit-I

Module 1: Introduction

Water Supply System – Planning, Objectives, Design Period, Population Forecasting, Water Demands and its Variations, Sources of Water and their Characteristics, Development and Selection of Source, Intakes and their Types.

Module 2: Water Characteristics

Sources of Impurities, Type of Impurities in Water and their Sanitary Significance, Physical, Chemical and Bacteriological Analysis of Water, Indian and Global Standards of Water Quality, Effluent Standards.

Unit-II

Module 3: Water Treatment

Necessity of Water Treatment , Flow Diagram of Different Treatment Units; Constructional Details, Working and Operation of Preliminary Units, Aeration Units, Sedimentation Units and their Types, Features and Design Aspects; Mixing Basins, Flocculation; Filtration – Mechanisms, Characteristics and Design of Slow and Rapid Sand Filtration Unit; Disinfection - Theory, Methods and Practices.

Module 4: Advanced Water Treatment

Water Softening, Desalination- R.O. Plant, Demineralization, Adsorption, Ion Exchange, Membrane Systems; Iron and Manganese Removal, Defluoridation, Dissolved Solids Removal.

Unit-III

Module 5: Water Conveyance System

Methods of Supply - Intermittent and Continuous, Pipes and Conduits for Water- Pipe Materials, Laying, Jointing and Testing of Pipes, Valves and Appurtenances

Module 6: Pumps and Pumping Stations

Need of Pumping, Terminology used, Classification of Pumps, Different Type of Pumps used in Water Supply, Power of Pumping, Total Lift of Pump, Location of Pumping Station, and Site Selection.

Unit-IV

Module 7: Water Distribution System

Requirements of Water Distribution, Type of Distribution System, Layout of Distribution System – Dead End System, Grid Iron System, Ring System, Radial System and their Merits and Demerits; Distribution Reservoir-Functions and Determination of Storage Capacity, Water Distribution Network- Layout, Capacity, Pressure Requirements, Analysis; Leak Detection and Maintenance of Water Distribution Network.

Module 8: Water Pollution and Control

Sources of Water Pollution, Types and their Effects, Preventive Measures and Control of Water Pollution, Description of Legislation Related to Water Pollution Control.

Course Outcomes

At the end of the course, the students will be able to

- Understand the sources of water and characterization of water including physical, chemical and biological water quality parameters.
- Develop basic knowledge about the transmission, storage and distribution of water.
- Knowledge of water pollution and its control.
- Recommend the degree of treatment required for the water.

References:

- Water Supply Engineering: S.R. Kshirsagar.
- Water Supply Engineering: S.K. Garg.
- Water Supply Engineering: B.C. Punmia.
- Environmental Engineering: Peavy H. S., Rowe D. R. and Tchobanoglous G.
- Introduction to Environmental Engineering: Davis M. L. and Cornwell D. A.
- Water Supply and Sanitary Engineering: Birdie, G. S. and Birdie 8. Manual on Water Supply and Treatment: Ministry of Urban Dev., New Delhi.

DESIGN OF STEEL STRUCTURE			
Course Code	PCC-CE-309-G	External marks:	75
Credits	4	Internal marks:	25
L-T-P	3-1-0	Total marks:	100
		Duration of Examination:	3 hrs

Course Objectives

- To learn IS 800-2007 code of practice for the design of Compression, Tension and Flexural members using various cross-sections.
- To study and design of various connections.
- To understand behaviour of flexural members and the design laterally restrained and unrestrained beams.
- To impart practical knowledge of steel structures and their application.

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

COURSE CONTENT

Unit-I

Module 1: Introduction

Stress Strain Curve for Steel, Composition and Properties of Structural Steel, Types of Steel Structures, Types of Sections, Stresses in Structural in Steel, Design Consideration, Codes and Specification, Introduction of Design Philosophies, Different Kind of Loads and their Combination.

Module 2: Connections

Terminology, Various Types of Connections and their Joints-Riveted, Bolted, Pin, Welded Connections; their Design for Different Loads, Modes of Failure

Unit-II

Module 3: Design of Tension Member

Types of Tension Members, Factors Affecting Strength of Tension Member, Design of Tension Members, Lug Angles, Splices, Gussets as per Indian Codal Provision.

Module 4: Design of Compression Members

Behaviour of Compression Members, Types of Compression Member, Effective Length, Slenderness Ratio, Sections Used for Compression Member, Flexural-Torsional Buckling, Prevention of Buckling Failure, Design of Compression Members, Design of Built Up Columns- laced and battened columns including the design of lacing and battens, Design of Compression Members Composed of Two Components Back-To-Back.

Unit-III

Module 5: Design of Beams

Different Types of Sections in Beams, Lateral Stability of Beam and Factors Affecting Lateral Stability, Design of Laterally Supported and Unsupported Beams, Web Buckling, Web Crippling, Diagonal Buckling, Torsional Buckling, Effect Of Holes In Beams.

Module 6: Design Column Bases and Footings

Types of Column, Bases-Slab Bases, Gusset Base, Design of Base plate and Gusseted Base, Design of Bases for Eccentrically Loaded Columns, Anchor Bolts and Shear Connectors, Grillage Foundation

Unit-IV

Module 7: Plastic Analysis and Design

Plastic Analysis- Scope, Theory and General Requirement, Ultimate Load-Carrying Capacity of Tension Members, Compression Members, Flexural Members, Shape Factor, Load Factor, Mechanisms, Plastic Collapse, Condition in Plastic Analysis, Method of Analysis, Plastic Analysis And Design of Steel Beams and Simple Portal Frames.

Module 8: Design of Gantry Girder

Loading Consideration, Selection Criteria of Gantry Girder, Specification, Design of Gantry girder

Course Outcomes

At the end of the course, the students will be able to:

- Apply the IS code of practice for the basic design of steel structural elements.
- Design compression and tension members using simple and built-up sections.
- Analyze the behaviour of bolted connections and design them.
- Design welded connections for both axial and eccentric forces
- Students will be able to understand the basic of steel structure with practical application.

References:

- Design of steel structures, A.S.Arya&J.L.Ajmani, Nemchand& Bros., Roorkee.
- Design of steel structures (LSM), N.,Subramanian, Oxford Publication.
- Design of steel structures, M.Raghupati, TMH Pub., New Delhi.
- Design of steel structures, S.M.A.Kazmi&S.K.Jindal, Prentice Hall, New Delhi.
- Design of steel structures, S.K.Duggal, TMH Pub, New Delhi.

ENGINEERING GEOLOGY			
Course Code	PCC-CE-311-G	External marks:	75
Credits	3	Internal marks:	25
L-T-P	2-1-0	Total marks:	100
		Duration of Examination:	3 hrs

Course Objectives

- To make the students familiar interior of Earth.
- To aware about different geological maps, different organizations related with geological study.
- To provide knowledge about geological forces and formation of Superficial Deposits.
- To make students study various minerals
- To aware about the basics of various types of rocks and their formation
- To provide adequate knowledge about geological considerations in civil engineering projects

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

COURSE CONTENT

Unit-I

Module 1: Introduction

Scope, Subdivision of Geology, Interior of Earth, Importance of Geological Studies in Various Civil Engineering Projects, Department Dealing with this Subject in India and their Scope of Work- GSI, Granite Dimension Stone Cell, NIRM; Use of Geological Maps and Interpretation of Data.

Module 2: Physical Geology

External and Internal Geological Forces Causing Changes; Weathering, Erosion and Denudation of the Surface of the Earth; Factors Affecting Weathering and Product of Weathering; Superficial Deposits and its Geotechnical Importance: Water Fall and Gorges, River Meandering, Alluvium, Glacial Deposits, Desert Landform, Loess, Mudflows, Coastal Deposits.

Unit-II

Module 3: Mineralogy

Origin and Composition of Minerals, Physical Properties of Minerals, Susceptibility of Minerals to Alteration, Rock Forming Minerals, Megascopic Identification of Common Primary and Secondary Minerals.

Module 4: Petrology

Rock Formation Processes, Ternary Diagram, Igneous Petrology- Volcanic Phenomenon, Types of Volcanic Eruption, Chemical and Mineralogical Composition, Texture and its Types, Sedimentary Petrology- Mode of Formation, Mineralogical Composition, Texture and its Types; Metamorphic Petrology- Agents and Types of Metamorphism, Metamorphic Grades, Mineralogical Composition, Structures and Textures.

Unit-III

Module 5: Structural Geology

Forms and Structures of Rocks, Stress and Strain in Rocks, Deformation and Tectonics, Dip and Strike, Bedding Planes and Outcrops; Fold- Types and Nomenclature, Criteria for Their Recognition in Field; Faults: Classification, Recognition in Field.

Module 6: Properties of Rock Masses

Sub Surface Investigations of Rocks and Engineering Characteristics of Rocks Masses; Field and Laboratory Tests on Rocks, Stress Deformation and Bearing Capacity of Rocks, Important Variables Influencing Rock Properties and Behaviour, Measurement of Velocity of Sound in Rock.

Unit-IV

Module 7: Geology of Dam and Reservoir Site

Geological Consideration for Selecting Dam and Reservoir Site, Causes of Failure of Reservoir, Favourable and Unfavourable Conditions in Different Types of Rocks in Presence of Various Structural Features, Precautions to Counteract Unsuitable Conditions.

Module 8: Geological Hazards

Rock Instability and Slope Movement; Concept of Sliding, Consequences of Land Sliding, Prevention by Surface Drainage, Slope Reinforcement by Rock Bolting and Rock Anchoring; Earthquake: Magnitude and Intensity of Earthquake, Seismic Waves; Seismic Zones in India.

Course Outcomes

At the end of the course, the students will be able to:

- To identify different minerals, their physical properties and rock forming minerals.
- To understand the basics of various types of rocks and their formations, texture, composition.
- To determine different geological forces and formation of Superficial Deposits.
- Conduct geological survey by knowing the interior of Earth.
- To study different geological maps with geological symbols.
- To acquire the knowledge about geological considerations in civil engineering projects.

References:

- A textbook of Geology by P.K Mukherjee
- Physical and General Geology by SK Garg
- Engineering and General Geology by Prabin Singh.
- Introduction of physical Geology by A.holmes

HIGHWAY ENGINEERING-I LAB			
Course Code	LC-CE-313-G	External marks:	25
Credits	1	Internal marks:	25
L-T-P	0-0-2	Total marks:	50

Course Objectives

- To understand the characterization of highway materials as per IRC/IS codes.
- To learn the mix designs of granular, bituminous and CC mixes
- To learn the use of modern equipment for traffic studies and pavement evaluation

List of Experiments

1. To determine the flakiness index and elongation index of aggregates.
2. To determine the California Bearing Ratio (CBR) value of soil and aggregate.
3. To determine the impact value of aggregate and composite material.
4. To determine the crushing strength of aggregate and composite material.
5. To determine the abrasion and attrition value of aggregate by using:
 - a) Deval abrasion test.
 - b) Los Angeles abrasion test
 - c) Dory abrasion test.
6. To determine the water absorption of aggregate.
7. To find out the durability of aggregate.
8. To determine the mechanical and wear properties of tiles/blocks:-a) Flexural strength b) Abrasion value of tiles/blocks.
9. Traffic volume and speed study using videography technique.(Demonstration only)

Course Outcomes

At the end of the course, the students will be able to:

- Gain Engineering knowledge of the subject and apply it for judging the suitability of highway materials.
- Make investigations, use modern test tools and develop solutions to use highway materials for sustainable development that preserves the environment.
- Understand the norms of engineering practice and the need for life-long learning as per their exposure to relevant IS/IRC specifications.

References:

- Khanna,S.K. and Justo, C.E.G.,Veeraragavan A.,“Highway Engineering”,Nem Chand &Bros.
- Khanna,S.K. and Justo,C.E.G.,“HighwayMaterialTestingManual”,NemChand& Bros.
- Kadiyali,L.R.,“TrafficEngineeringandTransportationPlanning”,Khanna Publishers.

SOIL MECHANICS LAB			
Course Code	LC-CE-315-G	External marks:	25
Credits	1	Internal marks:	25
L-T-P	0-0-2	Total marks:	50

Course Objectives

- To estimate index properties of soil.
- To estimate consistency limit of fine grained.
- To estimate shear strength of soils by direct shear test & unconfined compressive test.
- To estimate the engineering properties of the soils by density test, permeability test and consolidation test

List of Experiments

1. Visually classify the soil and to determine the moisture content (water content) of a given soil sample.
2. Determination of specific gravity of given soil sample.
3. To classify the coarse grained soil by sieve analysis using particle size distribution curve.
4. To determine liquid limit and plastic limit.
5. To determine field density of soil by
 - a. Sand replacement method
 - b. Core cutter method
6. To determine the optimum moisture content and maximum dry density of soil by Standard Proctor Test.
7. To determine the coefficient of permeability of soil sample at desired density by suitable method.
8. To determine the Unconfined compressive strength of cohesive soil sample.
9. To determine the shear strength parameters of the given granular soil sample at known density and moisture content by Direct shear test.
10. To determine the shear strength parameters of fine grained soil sample by unconsolidated undrained (UU) Triaxial test.

Course Outcomes

At the end of the course, the students will be able to:

- Determine index properties of soils.
- Students will learn and acquire knowledge to classify soils.
- To understand the techniques, skills and modern engineering tools necessary for engineering practice.
- Determine engineering properties of soils solutions.
- Classify soil by physical observation of the soils.
- Carry out interpolation among the estimated soil design parameters.

References:

- Soil Testing for Engineers by S.Prakash, PK Jain, Nem Chand & Bros.,Roorkee.
- Engineering Soil Testing by Lambi, Wiley Eastern.
- Engineering Properties of Soils and their Measurement by J.P.Bowles, McGraw Hill.
- Soil Engineering in Theory and Practice, Vol.II,
- Geotechnical Testing and Instrumentation by Alam Singh, CBS Pub.

DESIGN OF STEEL STRUCTURES DRAWINGS			
Course Code	LC-CE-317-G	External marks:	25
Credits	1	Internal marks:	25
L-T-P	0-0-2	Total marks:	50

Course Objectives

- To draw various steel connection.
- To draw various beam and column connections.
- Drawing of girders, different trusses and joints.
- To draw various steel members i.e. tension and compression members.

List of Experiments

1. To Prepare Detailed Drawing for various types of Bolted Connection.
2. To Prepare Detailed Drawing for various types of Welded Connection.
3. To Prepare Detailed Drawings for Laced And Battened Columns.
4. To Prepare Detailed Drawings of Built Up Beams.
5. To Prepare Detailed Drawing of Column Bases–Slab Bases–Gusset Base.
6. To Prepare Detailed Drawings of Grillage Foundations.
7. To Prepare Detailed Drawing of Beam to Column Connections.
8. To Prepare Detailed Drawings of Gantry Girder.
9. To Prepare Drawing of Plate Girder.
10. To Prepare Drawing of Circular and Rectangular Water Tank.
11. To Prepare Drawing of various types of Roof Trusses.

Course Outcomes

At the end of the course, the students will be able to:

- Understand the study of drawing for various components like connection, trusses, girders, joints etc.
- Implementation of design in drawing forms with by laws.
- Apply relevant Indian Standard provisions to ensure safety and serviceability of structural steel elements.

References:

- Structural design & Drawing, S. Krishnamurthy, Volume-3.
- Design & Drawing of steel Structure, Sajjan V. Wagh.
- Structural design & Drawing, reinforced concrete & Steel, N. Krishna Raju.
- Steel Structures (Design & Drawing), A.K. Upadhayay.

ENGINEERING GEOLOGY LAB			
Course Code	LC-CE-319-G	External marks:	25
Credits	1	Internal marks:	25
L-T-P	0-0-2	Total marks:	50

Course Objectives

- To study and identify different minerals with their physical properties.
- To aware about different types of rocks and rock forming minerals.
- To study the different geological formations.

List of Experiments

1. To Study physical properties of minerals.
2. To study and identify different minerals: Silica group, Feldspar group, Carbonate group and Pyroxene group.
3. To study and identify rocks forming silicate and ore minerals.
4. Identification of Igneous Petrology: Acidic Igneous rock: Granite and its varieties, Pumice, Scoria, Pegmatite and Volcanic Tuff.
5. Identification of Sedimentary Petrology: Sandstone and its varieties, Laterite, Limestone and its varieties, Shales and its varieties.
6. Identification of Metamorphic Petrology: Marble, Slate etc.
7. To determine Dip and strike of formations using
 - a) Clinometer
 - b) Brunton compass
8. Geological cross sections and Study of topographical features from Geological maps with identification of symbols.
9. Study of models of Geological structures and outcrops patterns of different types of rocks and landforms.

Course Outcomes

At the end of the course, students would be able to:

- To identify different materials and their physical properties.
- To identify different types of rocks on the basis of their formation.
- To identify geological symbols and make geological maps.
- To measure geological formations of different types.

References:

- A textbook of Geology by P.K Mukherjee
- Engineering and General Geology by Prabin Singh.

SURVEY CAMP			
Course Code	PT-CE-321-G	External marks:	25
Credits	2	Internal marks:	25
L-T-P	0-0-0	Total marks:	50

Course Objectives

- Survey camp emphasizes on field application of basic survey task such as triangulation, base line measurement, leveling, contouring and topographic surveying of land using plane table methods.
- It imparts knowledge of projection of land features on a plane sheet on a chosen scale.
- To make the student capable of drawing survey site plans and maps independently of a chunk of land of hilly area.

COURSE CONTENT

The survey camp is to be carried out by the students at suitable site. Different group of students will be asked to survey a particular area by using appropriate instruments issued to them. They will use different methods of surveying i.e. leveling, base line measurement, contouring, triangulation, plane table method to locate different control points. The students will plot important objects and features of the area under consideration on plane table sheet and prepare topographic map of the area.

Course Outcomes

At the end of the course, the students will be able to:

- Use instruments like Auto level, Total station, Tachometer and other important survey instrument.
- They will gain experience of preparing site maps of the objects in the area under consideration with contours.
- Make significant survey decisions on survey works whenever necessary especially when facing problems at sites.
- To carry out engineering survey work confidently.

Reference Books

- Punmia B.C., Surveying, Volume 1, Laxmi Publications.
- Punmia B.C. Surveying, Volume 2, Laxmi Publications.
- N N Basak, Surveying and Levelling TMH Private Ltd.

IRRIGATION ENGINEERING			
Course Code	PCC-CE-302-G	External marks:	75
Credits	4	Internal marks:	25
L-T-P	3-1-0	Total marks:	100
		Duration of Examination:	3 hrs

Course Objectives

- To make the students conversant with introduction to irrigation and national policies.
- To understand the basic methods of irrigation and soil water relation.
- To expose the students to water logging and land reclamation.
- To provide adequate knowledge regarding river training and canal outlet.
- To have adequate knowledge of drainage work.

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

COURSE CONTENT

Unit-I

Module 1: Introduction

Scope and Necessity of Irrigation, Different Water Resources, Development of Irrigation in India, Irrigation Systems and its various types, Benefits of Irrigation, National Water Policy, Impacts of Irrigation

Module 2: Water Requirement of Crops

Crops and Crop Seasons in India, Field Capacity, Wilting Point, Duty and Delta, Soil-Water Relationship- root zone soil water, infiltration, frequency of irrigation; Methods of Irrigation: Flooding Methods, Border Strip Method, Check Basin and Furrow Method, Sprinkler and Drip Irrigation Methods and their Design.

Unit-II

Module 3: Canal Regulation Works

Canal Fall- Necessity and Location, Types of fall, Cross Regulator and Distributory Head Regulators, Silt Control Devices, Canal Escapes and its Types.

Module 4: Cross Drainage Works

Classification, Site Selection Criteria, Factors Affecting the Selection of Cross Drainage Works, Hydraulic Design of- aqueducts, syphon aqueducts, super passage, canal syphon and level crossing

Unit-III

Module 5: Canal Outlets

Essential Requirements for an Outlet, Classification and Types of Outlets, Salient Features and Design: Pipe Outlet, APM Outlet and Open Flume Outlet; Flexibility Proportionality, Setting and Sensitivity of Outlet.

Module 6: Spillways and Energy Dissipations

Essential Requirements of Spillway and Spillway's Capacity, Types of Spillways and their Suitability, Ogee Spillways, Chute, Side Channel, Shaft and Syphon Spillways, Energy Dissipaters and its types ; Stilling Basins, USBR and IS Stilling Basins.

Unit-IV

Module 7: River Training

Objectives and Classification of River Training Works, Methods and Planning of River Training, Marginal Embankments, Guide Banks, Spurs, Cut Offs, Bank Protection and Launching Apron.

Module 8: Water Logging and Drainage

Water Logging- Effects, Causes & Preventive Measures, Land Reclamation: Process and Methods, Land Drainage, Benefits of Drainage, Essential Requirements of a Drain, Classification of Drains, its Operation and Maintenance.

Course Outcomes

At the end of the course, the students will be able to:

- Learn historical development of irrigation in India and the policies framed
- Learn about various methods of irrigation
- Understand water logging effects and methods of land reclamation
- Know about river training, classification and requirement of canal outlets and cross drainage works.

References:

- Garg, S. K., "Irrigation Water Power & Water Resources Engg." Standard Publishers & Distributors, Delhi, latest edition
- Modi, P.N. "Irrigation, Water Resources and Water Power Engg." Standard Book House, N. Delhi latest edition
- Arora, K R "Irrigation Water Power & Water Resources Engg." Standard Publishers & Distributors, Delhi, latest edition
- Sharma, S.K., Principles and Practice of Irrigation Engineering, S.Chand & Co., latest edition
- Punmia, B.C., "Irrigation and Water Power Engg." Standard Publishers, latest edition

FOUNDATION ENGINEERING			
Course Code	PCC-CE-304-G	External marks:	75
Credits	4	Internal marks:	25
L-T-P	3-1-0	Total marks:	100
		Duration of Examination:	3 hrs

Course Objectives

- To emphasize the importance of soil investigations.
- To provide the knowledge for carrying out field investigations and to identify soils in geotechnical engineering practice.
- To identify factors controlling soil behaviour and methods of dewatering.
- To understand different types of foundations and their importance in field.
- To identify different parameters for determining the bearing capacity of soil.
- To explain under which conditions deep foundation is needed and how to estimate pile and pile group capacity.
- To understand dynamic loading on soil foundation system and provide knowledge to lay out caissons and well foundation.

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

COURSE CONTENT

Unit-I

Module 1: Sub-Surface Exploration

Scope and Objectives, Stages in Soil Exploration, Depth and Lateral Extent of Exploration, Guidelines for Various Types of Structures, Ground Water Observations, Methods of Bore Holes, Soil Sampling and Disturbance, Major Types of Samplers, Sounding Methods-SPT, SCPT, DCPT and their Interpretation, Geophysical Methods, Pressure-Meter Test, Exploration Logs.

Module2: Drainage and Dewatering

Ditches and Sumps, Well Point Systems, Shallow Well System, Deep Well Drainage, Vacuum Method, Electro-Osmosis, Consolidation by Sand Piles.

Unit-II

Module 3: Shallow Foundations

Types of Foundations, Depth of Foundation, Types of Shallow Foundations and their Relative Merits, Design Criteria for Structural Safety of Foundation: i) Location of Footing, ii) Shear Failure Criterion, iii) Settlement Criterion. Modes of Shear Failure, Rankine's Analysis Terzaghi's Theory, Skempton's Formula, Meyerhoff's Bearing Capacity Theory, Effect of G.W.T. , Effect of Eccentricity on Bearing Capacity, Inclined Load, IS Code Recommendations.

Module 4: Settlement of Foundations

Various Causes of Settlement of Foundation, Allowable Bearing Pressure Based on Settlement, Elastic and Consolidation Settlement, Allowable Settlement According to IS Code Method, Plate Load Test and its Interpretation, Conventional Procedure of Proportioning of Footings, Situation Suitable for the Shallow Foundations.

Unit-III

Module 5: Bearing Capacity of foundations

Design Bearing Capacity, Bearing Capacity from Penetration Tests, Factors Affecting Bearing Capacity, Methods of Improving Bearing Capacity, Raft Foundations, Bearing Capacity of Raft in Sands and Clays, Various Methods of Designing Rafts, Seismic Considerations, Floating Foundations.

Module 6: Pile Foundations

Necessity of Pile Foundations, Classification of Piles, Selection Criteria, Load Capacity, Static Analysis, Analysis of Pile Capacity in Sands and Clays, Dynamic Analysis, Pile Load Tests, Negative Skin Friction, Batter Piles, Lateral Load Capacity, Uplift Capacity of Single Pile, Under-Reamed Pile, Batter Pile. Group Action in Piles, Pile Spacing, Pile Group Capacity, Stress on Lower Strata, Settlement Analysis, and Design of Pile Caps.

Unit-IV

Module 7: Drilled Piers and Caisson Foundations

Drilled Piers- Types, Uses, Bearing Capacity, Settlement and Construction Procedure; Caissons- Types, Bearing Capacity, Settlement and Construction Procedure

Module 8: Well Foundations

Shapes, Depth of Well Foundations, Components, Factors Affecting Well Foundation Design Lateral Stability, Construction Procedure, Sinking of Wells, Rectification of Tilts and Shifts, Recommended Values of Tilts & Shifts as per IS: 3955

Course Outcomes

At the end of the course, the students will be able to:

- To understand the importance of soil investigation and carry out sub-surface explorations for any civil engineering construction.
- To evaluate Bearing capacity factors and estimate bearing capacity using suitable methods.
- To do proper foundation proportioning for any kind of shallow foundation system.
- To estimate pile and pile group capacity for any kind of soils including group efficiency.
- To determine safe bearing capacity for various foundation system by considering shear and settlement criterion.

References:

- Murthy, V.N.S, A text book of Soil Mechanics and Foundation Engineering, UBS Publishers & Distributors Pvt. Ltd., New Delhi, latest edition
- Punmia, B.C., Soil Mechanics and Foundation Engineering, Laxmi Publications Pvt. Ltd., New Delhi, latest edition
- Gopal Ranjan, ASR Rao, Basic and Applied Soil Mechanics, New Age International Ltd. Publishers- N.Delhi, latest edition
- Nainan P Kurian, Design of foundation Systems Principles and Practices, Narosa, latest edition
- Braja M. Das, Principles of Foundation Engineering, Thomson Asia Pvt. Ltd., Singapore, latest edition
- Donald P. Coduto, Man-Chu Ronald Yeung and William A. Kitch, Geotechnical Engineering, Principles and Practices, PHI Learning Private limited, latest edition
- P.Purshotam Raj, Geotechnical Engg, Tata Mcgraw Hill, N.Delhi, latest edition

HIGHWAY ENGINEERING-II			
Course Code	PCC-CE-306-G	External marks:	75
Credits	4	Internal marks:	25
L-T-P	3-1-0	Total marks:	100
		Duration of Examination:	3 hrs

Course Objectives

- To understand the design of flexible and rigid pavements.
- To know the construction techniques of highways pavements.
- To understand the pavement failures and maintenance of pavements including strengthening.
- To learn economic evaluation of highway projects and sources of financing.

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

COURSE CONTENT

Unit-I

Module1: Design of Flexible Pavements

Types of Pavement, Components of a Pavement and their Functions, Factors Effecting Design of Pavements, Review of Design by Old Methods, Design of a Flexible Pavement by CBR Method (as per Latest IRC Guidelines). Pavement Performance and its Methods- AASHTO and Asphalt Institute.

Module 2: Design of Rigid Pavements

Westergaard's Theory and Assumption, Critical Locations of Loading, Load and Temperature Stresses, Critical Combination of Stresses, Joints: Types, Requirements and Patterns, Spacing of Expansion and Contraction Joints; Design and Functions of Dowel and Tie Bars, IRC and AASHTO Methods of Rigid Pavement Design.

Unit-II

Module 3: Construction of Bituminous Pavements

Various Types of Bituminous Constructions, Prime Coat, Tack Coat, Seal Coat and Surface Dressing; Construction of BUSG, Premix Carpet, BM, DBM and BC, Mastic Asphalt, Functions of Rollers, Paver and Hot Mix Plants, Introduction to Various IRC and MoRTH Specifications

Module 4: Highway Construction: Non-Bituminous Pavements

Subgrade and Embankment construction, Construction of GSB, WBM, WMM; Construction of DLC and PQC, Fixed Form and Slip-Form Paving Techniques

Unit-III

Module 5: Pavement Failure and Remedies

Classification of Distresses in Pavements (Functional and Structural); Different Types of Distresses in Flexible and Rigid Pavements along with the Causes and Remedial Measures; Various Types of Maintenance of Pavements; Evaluation of Pavements: Functional and Non- Destructive Evaluation

Module 6: Strengthening of Existing Pavement

Objective of Strengthening, Different Types of Overlay, Design of Flexible Overlays on Flexible Pavement using Effective Thickness Approach and Deflection Approach, Benkelman Beam Method, Design of Other Types of Overlays.

Unit-IV

Module 7: Highway Drainage and Hill Roads

Necessity and Significance of Drainage, Mode of Ingress of Water in Highway Structure, Surface Drainage: -Types and Brief Design, Types of Sub-Surface Drainage, Drainage Inking for the Roads in Hilly Areas, Special Characteristics of Hill Roads: Geometrics and Hair Pin Bends.

Module 8: Highway Economics and Finance

Need of Economic Evaluation, Highway User Benefits and Costs, Methods of Economic Evaluation, Highway Finance, PPP Projects, Rate Analysis of MoRTH-Standard Data Book and Cost Estimation

Course Outcomes

At the end of the course, the students will be able to:

- Gain Engineering knowledge of the subject and apply it for the solution of problems related to pavement engineering.
- Design flexible and rigid pavements, make investigations, use modern tools and develop solutions to problems related to highway pavements.
- Understand the engineering solutions in societal context for sustainable development that preserve the environment and economical use of resources.
- Understand the norms of engineering practice and the need for life-long learning as per their exposure to relevant latest IS/IRC/MoRTH specifications.

Reference:

- Highway Engg by S.K.Khanna& C.E.G. Justo, Veeraragavan A., Nem Chand Bros., Roorkee, latest edition
- Principles and Practice of Highway Engg. By L.R.Kadiyali, N.B. Lal, Khanna Publishers, Delhi, latest edition
- Principles of Pavement Design by Yoder, E.J. & Witczak, M.W., John Wiley and Sons, USA.
- Tunnel Engineering by S.C.Saxena, Dhanpat Rai Publications, N.Delhi.
- A text book of Tunnel, Bridges and Railway Engg. By S.P.Bindr, Dhanpat Rai Delhi

ENVIRONMENTAL ENGINEERING LAB			
Course Code	LC-CE-308-G	External marks:	25
Credits	1	Internal marks:	25
L-T-P	0-0-2	Total marks:	50

Course Objectives

- To quantify the water and wastewater pollutant.
- To analyze the physical characteristics of water and wastewater.
- To analyze the chemical characteristics of water and wastewater

List of Experiments

1. Determination of Turbidity of water by using suitable method
2. Determination of pH of given water sample.
3. Determination of Hardness of given water sample.
4. Determination of Residual Chlorine in given sample of water
5. Determination of Total Suspended and Dissolved Solids in given water sample.
6. Determination of Bio –chemical oxygen demand of waste water sample.
7. Determination of chemical oxygen demand of waste water sample.
8. Determination of Conductivity of given water sample.
9. Determination of Chlorides of given water sample
10. Determination of Alkalinity and Acidity of a given water sample.
11. Determination of Dissolved Oxygen of given waste water sample.

Course Outcomes

At the end of the course, the students will be able to:

- Quantify the water and wastewater pollutant.
- Estimate the physical characteristics of water and wastewater.
- Analyze the chemical characteristics of water and wastewater

References:

- Lab Manual, ISO 14001 Environmental Management, Regulatory Standards for Drinking Water and Sewage disposal.
- Clair Sawyer and Perry McCarty and Gene Parkin, “Chemistry for Environmental Engineering and Science”, McGraw-Hill Series in Civil and Environmental Engineering.
- Guide manual: Water & wastewater analysis, Central Pollution Control Board, Govt. of India.
- APHA standard methods for the examination of water and wastewater
- Water supply engineering, S.K. Garg

FOUNDATION ENGINEERING LAB			
Course Code	LC-CE-310-G	External marks:	25
Credits	1	Internal marks:	25
L-T-P	0-0-2	Total marks:	50

Course Objectives

- To aware the students about hydrometer method.
- To estimate the relative density and maximum dry density of soils.
- To aware the importance of SPT, consolidometer and Triaxial test for selection of foundation.
- To estimate shear strength parameters of soil by Triaxial shear test.
- To estimate consolidation parameters of clayey soil.
- To aware about the importance of sampling and aware about the significance of plate load test.

List of Experiments

1. To determine grain size analysis using Hydrometer method.
2. To determine relative density of granular Soils.
3. To determine shrinkage limit of fine grained soil
4. To determine shear strength properties for consolidated drained conditions using Triaxial test.
5. To determine shear strength properties for consolidated undrained condition using Triaxial test.
6. To determine consolidation parameters using consolidometer.
7. To determine bearing capacity parameters using Standard Penetration Test.
8. Demonstration of Undisturbed Sampling.
9. Demonstration of cone penetration test.
10. To study of Model Plate Load Test.

Course outcomes

At the end of the course, the students will be able to:

- Classify soil using hydrometer method and estimate relative density of soils.
- To perform Triaxial test under different conditions.
- To understand the procedure and calculations of SPT and prepare soil investigation report.
- Carry out interpolation tests to determine consolidation and estimate shear strength parameters.
- To obtain soil sampling by suitable method.
- Determine essential parameters of plate load test.

References:

- Gopal Ranjan, ASR Rao, Basic and Applied Soil Mechanics, New Age International (P) Ltd. Publishers- N.Delhi, latest edition
- P. Purshotam Raj, Geotechnical Engg, Tata Mcgraw Hill, N.Delhi, latest edition

HIGHWAY ENGINEERING-II LAB			
Course Code	LC-CE-312-G	External marks:	25
Credits	1	Internal marks:	25
L-T-P	0-0-2	Total marks:	50

Course Objectives

- To understand the characterization of highway materials.
- To learn the mix designs of granular, bituminous, CC mixes and composite materials.
- To learn the use of modern equipment for traffic studies & pavement evaluation.
- To know the standard specifications of IS/IRC/MoRTH for judging suitability of these materials

List of Experiments

1. To determine the flash and fire point of bituminous material.
2. To determine the softening point of paving bitumen.
3. To determine the specific gravity of bituminous material.
4. To determine ductility of bitumen.
5. To determine the hardness of bitumen.
6. To determine the grade of a given binder.
7. To determine the viscosity of bituminous material.
8. To determine the granular mix design.
9. To determine the bituminous mix design by Marshall's method.
10. To determine the cement concrete mix design for pavements.
11. Demonstration of BBD & Bump Integrator.

Course Outcomes

At the end of the course, the students will be able to:

- Gain engineering knowledge of the subject and apply it for judging the suitability of highway materials.
- Make investigations, use modern test tools and develop solutions to use highway materials for sustainable development that preserves the environment.
- Understand the norms of engineering practice and the need for life-long learning as per their exposure to relevant IS/IRC specifications.

References:

- Highway Engg by S.K.Khanna & C.E.G. Justo, Veeraragavan A., Nem Chand Bros., Roorkee, latest edition
- Principles and Practice of Highway Engg. By L.R.Kadiyali, N.B. Lal, Khanna Publishers, Delhi, latest edition

COMPUTER-AIDED CIVIL ENGINEERING DESIGN			
Course Code	LC-ESC-314-G	External marks:	25
Credits	2	Internal marks:	25
L-T-P	1-0-2	Total marks:	50

Course Objectives

- To develop, analyze and design the various structural members in the fields of Civil Engineering using AutoCAD, STAAD Pro.
- To understand the design of structures using IS codes
- To provide the knowledge about methods of analysis and design of RCC and steel frames.

List of Experiments

1. To study the commands used in plans of buildings using AutoCAD.
2. To prepare 2 D architectural drawing
3. To prepare 3 D architectural drawing
4. To prepare the drawing of grillage foundation using Auto cad.
5. To study the commands used in modelling and design of structure using STAAD-Pro.
6. Analysis of 2D Frames.
7. Analysis of 3D Frames.
8. Design of 2D RCC frames and 2D Steel frames according to IS codes.
9. Design of 3D RCC frames and 3D Steel Frames according to IS codes.
10. Design of beams.
11. Analysis of truss frames.

Course Outcomes

At the end of the course, the students will be able to:

- To understand and learn the various codal provisions.
- Ability to prepare 2D and 3 D plans of buildings.
- To efficiently analyze and design of beams, truss frames and staircase.
- To perform various methods of analysis of 2D, 3D frames.

References:

- STAAD Pro Manual.
- IS 456, IS 1893, IS 800, IS 875.

WASTE WATER TREATMENT			
Course Code	PEC-CEEL-302-G	External marks:	75
Credits	3	Internal marks:	25
L-T-P	2-1-0	Total marks:	100
			Duration of Examination: 3 hrs

Course Objectives

- To learn basics of sewage collection and design of sewers
- To learn the basics of sewage composition and its characteristics
- To have adequate knowledge about various sewage treatment processes and its design
- To provide adequate information on various disposal standards for treated effluents

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

COURSE CONTENT

Unit-I

Module 1: Introduction

Importance and Necessity of Sanitation, Terms used in sanitation- Sullage, Sewage, Sewer and Sewerage, Sewerage Systems and their Suitability, Dry Weather Flow, Factors Affecting Dry Weather Flow, Flow Variations and their Effects on Design of Sewerage System.

Module 2: Design of Sewers

Types of Sewers and their Hydraulic Design, Material used for Sewer Construction, Joints and Sewer Appurtenances, Layout, Construction and Testing of Sewer Lines, Velocity in Sewers, Storm Water Sewers

Unit-II

Module 3: House Drainage

Principles of House Drainage, Types of Pipes used for Drainage, Classification and Functions of Traps, Sanitary Fitting, System of Plumbing, House Drainage Plan and Ventilation of House Drainage.

Module 4: Wastewater Characteristics

Quality Parameters- Physical, Chemical and Biological Characteristics, Oxygen Demand, Indian Standards for Disposal of Effluents into Inland Surface Sources and on Land, Guidelines for Reuse of Treated Wastewater

Unit-III

Module 5: Primary Sewage Treatment

Objectives, Flow chart of Conventional Treatment Units and their Efficiencies, Preliminary Treatment, Screening and Grit Removal Units, Principle, Types and Design of Primary Sedimentation Tank, Coagulation Aided Sedimentation Tank, Flocculation,

Module 6: Secondary Sewage Treatment

Concept of Organic Matter Removal, Aerobic and Anaerobic Treatment Processes, Activated Sludge Process, Conventional and Extended Aeration Systems, Trickling Filters, Aerated Lagoons, septic tank, Waste Stabilization Ponds, Oxidation Ditches, Up-Flow Anaerobic Sludge Blanket Process.

Unit-IV

Module 7: Sludge Treatment

Objectives, Sludge Digestion, Digestion and Disposal of Primary and Secondary Sludge, Factors Affecting Sludge Digestion, Thickening of Sludge, Anaerobic Digestion of Sludge, Sludge Digestion Tank, Sludge Conditioning and Dewatering, Sludge Drying Bed

Module 8: Sludge Disposal

Standards of Wastewater Disposal, Modes of Disposal of Treated Sludge, Self-Purification of Streams, Oxygen Sag Curve, Sewage Farming, Sodium Hazards, Soil Dispersion System

Course Outcomes

At the end of the course, the students will be able to:

- Estimate quantity of sewage and design sewerage system
- Determine the various characteristics of sewage
- Design various sewage treatment units
- Plan reuse of treated effluent and select appropriate disposal option

References:

- Environmental Engineering: Peavy H. S., Rowe D. R. and Tchobanoglous G.
- Wastewater Engineering, Collection, Treatment and Disposal: Metcalf and Eddy
- Water Supply and Sanitary Engineering: Birdie, G. S. and Birdie
- Sewage and Sewage Treatment: S.K. Garg.
- Sewage and Sewage Treatment: S.R. Krishansagar.
- Waste Water Engineering: B.C. Punmia.
- Manual on Sewerage and Sewage Treatment: Ministry of Urban Dev., New Delhi.

AIR AND NOISE POLLUTION CONTROL			
Course Code	PEC-CEEL-304-G	External marks:	75
Credits	3	Internal marks:	25
L-T-P	2-1-0	Total marks:	100
		Duration of Examination:	3 hrs

Course Objectives

- Understanding of basic concepts of air pollution.
- To understand the basic characteristics of air pollutants.
- To provide adequate knowledge about the noise pollution.
- To have adequate knowledge on various type of sounds.

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

COURSE CONTENT

Unit-I

Module 1: Air Pollution

Composition and Structure of Atmosphere, Air Pollution and Global Climate, Air Quality Criteria, Emission Standards, National Ambient Air Quality Standards, Air Quality Management in India

Module 2: Sources, Classification and Effects

Sources and Classification of Air Pollutants, Type of Air Pollutants, Pollution due to Automobiles, Analysis of Air Pollutants – Chemical, Instrumental and Biological Methods; Air Pollution and its Effects on Human health, plants, animals and microbes, archaeological monuments and aesthetics,

Unit-II

Module 3: Pollutant Dispersion

Concept of Atmospheric Stability, Adiabatic and Environmental Lapse Rate, Plume Behaviour, Terrain and Structure on Pollutant Dispersion, factors affecting Pollutant Dispersion, Concept of Maximum Mixing Depth and Ventilation Coefficient, Plume Rise and Effective Stack Height.

Module 4: Air Quality

Objectives, Time and Space Variability in Air Quality; Air Sampling Design, Analysis and Interpretation of Air Pollution Data, Introduction to Air Quality Index and Comprehensive Environmental Pollution Index and its Application, Sampling and Measurement of Air Pollutants Guidelines of Network Design in Urban and Rural areas, Stack Monitoring.

Unit-III

Module 5: Dispersion Modelling and Impacts of Air Pollution

Dispersion modelling, its Applications and Limitations, Gaussian Plume Model and GLC Determination, Global Environmental Issues: Acid Rain, Global Warming, Smog, Ozone layer depletion, Combustion of Fuel, Indoor Air Pollution, Various Treaties and Protocols: Kyoto Protocol and Montreal Protocol.

Module 6: Air Pollution Control

Introduction to Control Methods and Equipment for Particulate Matter and Gases, Design and Working of Scrubbers, Electrostatic Precipitator, Gravity Settlers, Cyclone Separator, Filter Bags, Adsorption by Liquids, Adsorption by Solids, Combustion Odours and their Control

Unit-IV

Module 7: Noise Pollution

Sound and Noise, Sources of Noise Pollution – Environmental and Industrial, Characteristics of Sound and its Measurement, Levels of Noise, Noise Rating Systems, Noise Level Standards, Outdoor and Indoor Noise Propagation; Psychoacoustics and Noise Criteria Curves

Module 8: Effects of Noise and Control Methods

Effects on Human and Environment, Infra-Sound, Ultrasound, Impulsive Sound and Sonic Boom; Noise Standards and Permissible Values; Instrumentation and Monitoring Procedure, Noise Indices and Control Methods

Course Outcomes

At the end of the course, the students will be able to

- To understand various air pollutants
- Analyze various types of noises.
- To understand various methods of control of air pollution.
- To understand various methods of control of noise pollution.

References:

- Air and Noise Pollution Control : Lawrence K. Wang
- Advanced Air and Noise Pollution Control: Volume 2 : Lawrence K. Wang
- Environmental Pollution and Health : V. K Ahluwalia
- Atmospheric pollution: Mark Z. Jacobson

ENVIRONMENTAL IMPACT ASSESSMENT			
Course Code	PEC-CEEL-306-G	External marks:	75
Credits	3	Internal marks:	25
L-T-P	2-1-0	Total marks:	100
		Duration of Examination:	3 hrs

Course Objectives

- To know the various types of environmental pollution.
- To understand various EIA techniques.
- To provide adequate knowledge about the noise pollution.
- To have adequate knowledge on various type of sounds.

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

COURSE CONTENT

Unit-I

Module 1: Introduction

Introduction Environment: Definition, Scope, Components, Structure and Composition. Environmental Quality, Monitoring and Base Line Data.

Module 2: Sustainable Development

Present and Future Development Needs; Exploitation of Natural Resources, Environmental Harmony, Economic Efficiency and Social Justice, Symbiotic Relationship, Concept of Carrying Capacity

Unit-II

Module 3: Environmental pollution

Environmental pollution due to increasing growth rate, population and human interaction; Air Pollution: Sources, Effects and its Control Measures; Water Pollution: Point and Non-point Source of Pollution, Major Pollutants of Water, Impact of pollutants and its Control Measures; Noise Pollution: Sources, Effects and its Control Measures

Module 4: Evolution of EIA

Scope, Preliminary Screening Requiring EIA of projects, Impact identification, Assessment of Impact; Impact Evaluation, Types of EIA, rapid and comprehensive, Plan for mitigation of adverse impact on environment – Options for mitigation of impact on water, air and land, energy, flora and fauna; addressing the issues related to the project affected people

Unit-III

Module 5: EIA Methodology

Impact Analysis: identification, predication, evaluation; Impact Identification Methods: overlays method, ad-hoc method, Checklist method, Matrices method, Fault Tree Analysis, Event Tree Analysis, Role of an Environmental Engineer,

Module 6: Environmental Audit

Cost Benefit Analysis; Life Cycle Assessment; Resource Balance, Energy Balance, management Review of Environmental Audit; Operational Control;

Unit-IV

Module 7: Case Studies of EIA

Standards for Water, Air and Noise Quality and their indices - Environmental Management Plan, EIA case studies for new and expansion projects: township projects, river valley projects, thermal power plants and industrial plants.

Module 8: Environmental Management

Preventive Policy of Environment, Waste Minimisation, Conservation of Water and Energy, Use of Renewable Sources, Pollution Control Strategy, Disposal of Treated Effluents, Solid Waste Disposal, Concept of Green Cities, Green Belt Development – Case History, Environment Management Plan – ISO 14000

Course Outcomes

At the end of the course, the students will be able to

- Analyze various EIA techniques
- Analyze various types of pollutions.

References:

- Environmental Impact Assessment: Cutting Edge for the 21st Century : Alan Gilpin
- Environmental Impact Assessment : Larry W Canter
- Environmental Impact Assessment: A Methodological Approach : Richard K. Morgan

ADVANCED CONCRETE STRUCTURE			
Course Code	PEC-CEEL -308-G	External marks:	75
Credits	4	Internal marks:	25
L-T-P	3-1-0	Total marks:	100
		Duration of Examination:	3 hrs

Course Objectives

At the end of this course, the student should be able to impart understanding of designing specialized RCC structures. To prepare the detailed structural drawings for execution purpose

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

COURSE CONTENT

Unit-I

Module1: Continuous Beams

Basic Assumptions, Moment of inertia, Settlements, Modification of Moments, Maximum Moments and Shear, Design Examples.

Module2: Curved Beams

Analysis for Torsion, Redistribution of Moments for Single and Multi-Span Beams, Design of Circular Beams Supported on Symmetrically Placed Columns, Semi-Circular Beams Supported on Equally Spaced Column, Design examples.

Unit-II

Module 3: Flat Slab

Advantages of Flat Slab, General Design Considerations, Indian Code Recommendations, Approximate Direct Design Method, Equivalent Frame method, Design of Flat Slabs, Openings in Flat Slab

Module 4: Yield Line Theory

Basic Assumptions, Yield Line Patterns and Failure Mechanisms, Ultimate Load on Slab, Design Example.

Unit-III

Module 5: Liquid Retaining Structure

Design Concepts of Liquid Retaining Structures, Design of Tanks Resting on Ground, Underground Tanks and Overhead Service Reservoirs, Staging and Foundation Design.

Module 6: Stair Case

Various Types of Staircases, General Notes on Design of Stair, Design Examples.

Unit-IV

Module 7: Design of Joints

Types of Joints, Joints in Multi-Storied Buildings, Forces Acting on Joints, Design of Joints for Strength, Anchorage Requirement in Joints, Detailing of Reinforcement in Joints.

Module 8: Building Frames

Introduction, Members Stiffness, Torsion in Buildings, Design Loads on Building Frames Including Wind and Earthquake Loads, Earthquake Resistant Design using Software, Introduction to IS: 13920 and Concepts of Ductile Detailing in Building Frames, Design and Detailing for Ductility, Design Examples.

Course Outcomes

At the end of the course, the students will be able to:

- Design advanced RCC structures.
- Prepare detailed structural drawings for the designed RCC structures using software.

References:

- “Advanced Reinforced Concrete Design”, P.C. Varghese, Prentice Hall of India Pvt. Ltd.
- “Plain & Reinforced Concrete,” Jain & Jai Krishan (Vol. I & Vol-II), Nem Chand and Bros.
- “Reinforced Concrete Structures”, Syal and Goel, S. Chand & Company Pvt. Ltd.
- “Reinforced Concrete Design”, S.U. Pillai & Devdas Menon, Tata McGraw Hill.
- "Reinforced Concrete Limit State Design" A.K. Jain, Nem Chand and Bros.

PRE-STRESSED CONCRETE			
Course Code	PEC-CEEL-310-G	External marks:	75
Credits	4	Internal marks:	25
L-T-P	3-1-0	Total marks:	100
		Duration of Examination:	3 hrs

Course Objectives

- To introduce the need for prestressing as well as the methods, types and advantages of prestressing to the students.
- Students will be introduced to the design of pre-stressed concrete structures subjected to flexure and shear.
- To make them familiar with design of typical pre-stressed concrete structural elements and to have a knowledge of the codal provisions.

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

COURSE CONTENT

Unit-I

Module 1: Material Properties and Prestressing Systems

Introduction of Prestressing system- history, types, source, advantages and its limitations, Prestressing Systems and Devices

Materials properties- Constituents of Concrete and their Properties, Stress-Strain Curves for Concrete, Constituents of Prestressing Steel and their Properties, Types of Prestressing Steel, Stress-Strain Curves for Prestressing Steel, Relaxation of Steel, Fatigue, Codal Provisions.

Module 2: Losses in Prestress

Elastic Shortening, Pre-Tensioned & Post-Tensioned - Axial & Bending Members, Losses in Prestress - Friction, Anchorage Slip, Creep of Concrete, Shrinkage of Concrete, Relaxation of Steel, Total Time-Dependent Loss, Force Variation Diagram.

Unit-II

Module 3: Analysis and Design for Shear and Torsion

Analysis for Shear- Introduction, Types of Cracks, Components of Shear Resistance, Modes of Failure, Effect of Prestressing Force, Stress in an Uncracked Beam, Design and Detailing Requirement for Shear, Design of Transverse Reinforcement.

Analysis for Torsion-Introduction, Crack Pattern Under Pure Torsion, Components of Resistance for Pure Torsion, Modes of Failure, Effect of Prestressing Force for Torsion, Stresses in an Uncracked Beam, Design and Detailing Requirement for Torsion, Design of Longitudinal Reinforcement and Transverse Reinforcement.

Module 4: Calculations of Deflection and Crack Width

Factors Influencing Deflections, Short Term Deflections of Uncracked Members, Prediction of Long Term Deflections due to Creep and Shrinkage, Check for Serviceability Limit State of Deflection. Deflection due to Gravity Loads and Prestressing Force, Total Deflection, Determination of Moment of Inertia, Calculation of Crack Width, Method of Calculation, Limits of Crack Width.

Unit-III

Module 5: Analysis of Members

Analysis of Members under Axial and Flexural Load- Based on Stress, Force and Load Balancing Concept. Cracking Moment, Kern Point, Pressure Line, Analysis for Ultimate Strength, Variation of Stress in Steel Condition at Ultimate Limit State, Analysis of Rectangular Sections, Flanged Sections, Partially Pre-Stressed Sections, Un-Bonded Post-Tensioned Beams.

Module 6: Design of Members

Design of Members for Axial Tension, Flexure Type I and Type II, Choice of Sections, Determination of Limiting Zone, Post-Tensioning in Stages, Magnel's Graphical Method, Guyon's Method

Unit-IV

Module 7: Composite and Continuous Beams

Analysis and Design of Composite Beams – Methods of Achieving Continuity in Continuous Beams, Analysis for Secondary Moments, Concordant Cable and Linear Transformation, Calculation of Stresses, Principles of Design.

Module 8: Miscellaneous Structures

Design of Tension and Compression Members, Tanks, Pipes and Poles, Partial prestressing – definition, methods of achieving partial prestressing, merits and demerits of partial prestressing.

Course Outcomes

At the end of the course, the students will be able to:

- Analyse prestressed concrete members
- Design prestressed concrete members using codal provisions
- Design for shear and torsion of prestressed concrete members
- Design end blocks and provide detailing of reinforcements
- Design composite members and other applications
- Design continuous members

References:

- Rajagopalan.N, "Prestressed Concrete", Narosa Publishing House, latest edition
- Dayaratnam.P., "Prestressed Concrete Structures", Oxford and IBH, latest edition
- Lin T.Y. and Ned.H.Burns, "Design of prestressed Concrete Structures", Third Edition, Wiley India Pvt. Ltd., New Delhi, latest edition
- IS1343:1980, Code of Practice for Prestressed Concrete, Bureau of Indian Standards,

REPAIR & REHABILITATION OF STRUCTURE			
Course Code	PEC-CEEL-312 G	External marks:	75
Credits	4	Internal marks:	25
L-T-P	3-1-0	Total marks:	100
		Duration of Examination:	3 hrs

Course Objectives:

This course has been designed with an aim to give the students an insight into the subject of concrete repair, its protection and strengthening

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

COURSE CONTENT

Unit-I

Module 1: Introduction

Overview of Distress, Deterioration in Concrete Structures, Global Scenario of Distressed Structures, Need for Repairs and Upgrading of Structures, Process for Durable Concrete Repair

Module 2: Deterioration of concrete structures

Types of Deterioration - causes & symptoms, mechanism & micro-structure of concrete, Physical and Chemical Deterioration and its factors, Deterioration due to Water Leakage, Fire – detection & mitigation, Deterioration due to Ageing and Inadequate Maintenance, Design & Construction Deficiencies like Overloading.

Unit-II

Module 3: Visual deterioration of structures

Types of Cracks, Causes & Characteristic of Cracking in Various Structural Components, Measurement of Cracks and Interpretation of the Cracking Phenomena

Module 4: Conditional/damage assessment & Evaluation of structures

Structural Assessment- importance, objective, various stages, conditional evaluation of the structure, Damage Assessment Procedure, Preliminary & Detailed Investigation – scope, objectives, methodology & rapid visual inspection of structures , Damage Assessment Allied Tests (Destructive, Semi-Destructive and Non-Destructive), Field & Laboratory Testing Procedures- strength, corrosion activity, performance & Integrity, Durability.

Unit-III

Module 5: Repairs of concrete structures

Repairing Materials- criteria, selection of repair materials, methodology, performance requirements, preparatory stage of repairs, different types of repair materials & their application and repair techniques

Module 6: Retrofitting/Strengthening

Need for Retrofitting, Design Philosophy of Strengthening Structures, Conventional and Advanced Techniques Available for Strengthening, Seismic Retrofit of Concrete Structures- deficiencies in

structure requiring seismic retrofit and its design philosophy, Latest Techniques to Enhance the Seismic Resistance of Structures.

Unit-IV

Module 7: Protection & maintenance of structures

Importance of Protection & Maintenance, Categories of Maintenance, Building Maintenance, Corrosion Mitigation Techniques

Module 8: Structural health monitoring (SHM)

Definition and Motivation for SHM, Basic Components of SHM and its Working Mechanism, SHM as a Tool for Proactive Maintenance of Structures

Course Outcomes

At the end of the course, the students will be able to:

- Identify and define all the terms and concepts associated with deterioration of concrete structures.
- Carry out the damage assessment and Rapid Visual inspection of a building showing signs of deterioration and thus should be able to detect the possible cause /source of deterioration.
- Develop a knowhow of the Concrete repair industry equipped with variety of repair materials and techniques.
- Describe and apply the importance of quality control in concrete construction and significance of protection and maintenance of structures.

References:

- Concrete microstructure, Properties and materials – P Kumar Mehta and Paulo J.M.Monterio.
- Handbook on Repairs and Rehabilitation of RCC buildings – CPWD, Government of India.
- Concrete Technology by M.L.Gambhir, Tata McGraw-Hill Education, Third Edition
- V. M. Malhotra, Nicholas J. Carino 2004 “Handbook on Nondestructive Testing of Concrete”
- “Repair and Strengthening of Concrete structures” , FIP guide, Thomas Telford, London.
- Concrete Structures, Protection, Repair and Rehabilitation by R.Dodge Woodson.
- Repairs and rehabilitation of concrete structures by P. I. Modi & C. N. Patel, PHI Publication.